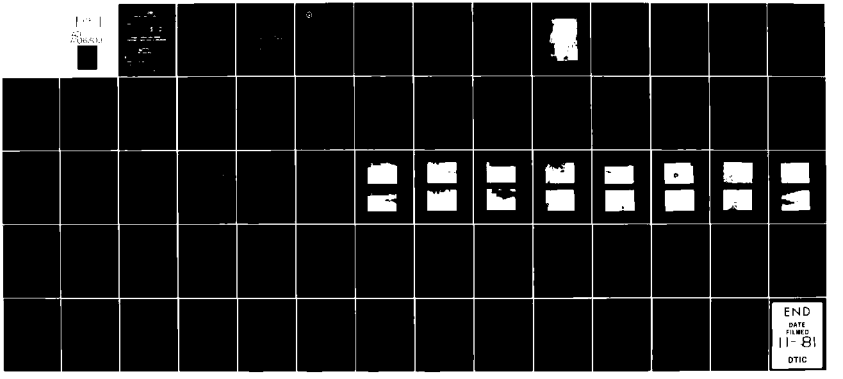
AD-A106 309 BLACK AND VEATCH KANSAS CITY MO F/G 13/13
NATIONAL DAM SAFETY PROGRAM. BECKEMEYER LAKE DAM (MO 11227), MI--ETC(U)
MAY 80 P R ZAMAN, E R BURTON, H L CALLAHAN DACW43-80-C-0074
UNCLASSIFIED NL



END
DATE FILMED
11-81
DTIC

LEVEL II

MISSOURI-KANSAS CITY BASIN

1

AD A106309

[redacted] LAKE DAM

LAFAYETTE COUNTY, MISSOURI

MO 10007

DTIC
ELECTE
S OCT 28 1981 D
E

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DTIC FILE COPY

United States Army
Corps of Engineers
St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

MAY 1980

81 10 26 080

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1 REPORT NUMBER	2 GOVT ACCESSION NO	3 RECIPIENT'S CATALOG NUMBER
4 TITLE (and Subtitle) [illegible] 9	5 TYPE OF REPORT & PERIOD COVERED Final Report
	6 PERFORMING ORG REPORT NUMBER
7 AUTHOR(s) 15	8 CONTRACT OR GRANT NUMBER(s)
9 PERFORMING ORGANIZATION NAME AND ADDRESS	10 PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11 CONTROLLING OFFICE NAME AND ADDRESS	12 REPORT DATE May 1979 13
	13 NUMBER OF PAGES
14 MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) 10 Paul R. Zaman Edwin R. Hutton Harry L. Callahan	15 SECURITY CLASS. (of this report) UNCLASSIFIED
	15a DECLASSIFICATION/DOWNGRADING SCHEDULE

16 DISTRIBUTION STATEMENT (of this Report)

17 DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

6 National Dam Safety Program. Beckemeyer Lake Dam (MO 11221), Missouri - Kansas - Iowa Basin, Lafayette County, Missouri. Phase I Inspection Report.

18 SUPPLEMENTARY NOTES

19 KEY WORDS (Continue on reverse side if necessary and identify by block number)

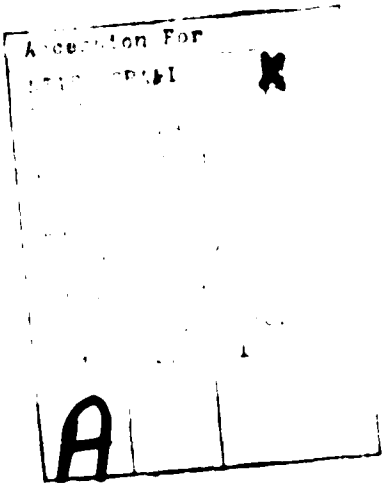
20 ABSTRACT (Continue on reverse side if necessary and identify by block number)

[illegible]

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE 038320 UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

MISSOURI-KANSAS CITY BASIN



BECKEMEYER LAKE DAM

LAFAYETTE COUNTY, MISSOURI

MO 11227

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
Serving the Army
Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

MAY 1980

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD NORTH
ST. LOUIS, MISSOURI 63101

LMSED-PD

SUBJECT: Beckemeyer Lake Dam, MO. I.D. No. 11227
Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Beckemeyer Lake Dam.

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

a. Spillway will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.

b. Overtopping of the dam could result in failure of the dam.

c. Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED — 24 SEP 1980
Chief, Engineering Division — Date

APPROVED BY: SIGNED — 25 SEP 1980
Colonel, CE, District Engineer — Date

BECKEMEYER LAKE DAM

LAFAYETTE COUNTY, MISSOURI

MISSOURI INVENTORY NO. 11227

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY:

BLACK & VEATCH
CONSULTING ENGINEERS
KANSAS CITY, MISSOURI

UNDER DIRECTION OF

ST. LOUIS DISTRICT CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

MAY 1980

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Beckemeyer Lake Dam
State Located	Missouri
County Located	Lafayette County
Stream	Tributary to Hicklin Branch
Date of Inspection	22 May 1980

Beckemeyer Dam was inspected by a team of engineers from Black & Veatch, Consulting Engineers for the St. Louis District, Corps of Engineers. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and state agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. According to the St. Louis District, Corps of Engineers, failure would threaten lives and property. The estimated damage zone extends approximately two miles downstream of the dam. Within the estimated damage zone are four dwellings, two roads including U.S. Route 24, and two trailers. Contents of the estimated damage zone were verified by the inspection team.

Our inspection and evaluation indicates the spillway does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The spillways will not pass the probable maximum flood without overtopping but will pass 10 percent of the probable maximum flood. The spillways will not pass the estimated flood which has one percent chance of occurrence in any given year (100-year flood). The spillway design flood recommended by the guidelines is 50 to 100 percent of the probable maximum flood. Considering the small volume of water impounded behind the dam, the valley below the dam and the hazard zone, the spillway design flood should be 50 percent of the probable maximum flood. The probable maximum flood is defined as the flood discharge which may be expected from the most severe combination of critical meteorologic and hydrologic conditions which are reasonably possible in the region.

Based on visual observations, this dam appears to be in fair condition. Deficiencies visually observed by the inspection team were seepage and erosion at the interface of the embankment and the left abutment, seepage downstream of the dam, erosion in the emergency spillway, and numerous animal burrows particularly on the upstream slope. Seepage and stability analyses required by the guidelines were not available.

There were no observed deficiencies or conditions existing at the time of the inspection which indicated an immediate safety hazard. Future corrective action and regular maintenance will be required to correct or control the described deficiencies. In addition, detailed seepage and stability analyses of the existing dam, as required by the guidelines, should be performed. A detailed report discussing each of these deficiencies is attached.

Paul R. Zaman, PE
Illinois 62-29261

Edwin R. Burton, PE
Missouri E-10137

Harry L. Callahan, Partner
Black & Veatch

OVERVIEW OF DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
BECKEMEYER LAKE DAM

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

LIST OF PLATES

LIST OF PHOTOGRAPHS

TABLE OF CONTENTS (Cont'd)

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the District Engineer of the St. Louis District, Corps of Engineers, directed that a safety inspection of the Beckemeyer Lake Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed with the help of several Federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is an earth structure located in the valley of a tributary to Hicklin Branch, a tributary of the Missouri River (Plate 1). The watershed is an area of low hills consisting of timber and crop land (Plate 2). The dam is approximately 375 feet long along the crest and 31 feet high. The dam crest is 16 feet wide. The downstream face of the dam has an irregular slope from the crest to the valley floor below.

(2) The primary spillway from the lake is an uncontrolled 15-inch beveled steel pipe with a canopy inlet installed in the embankment. Flow through the pipe discharges into the natural stream channel below. The emergency spillway consists of a notch cut in the abutment. Discharge through the emergency spillway flows around the east end of the dam to the natural stream channel.

(3) Pertinent physical data are given in paragraph 1.3.

b. Location. The dam is located in Lafayette County, Missouri. The location is shown on Plate 1. The lake formed by the dam is shown on the United States Geological Survey 7.5 minute series quadrangle map for Bates City, Missouri in Section 26 of T50N, R29W.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, the dam and impoundment are in the small size category.

d. Hazard Classification. The hazard classification assigned by the Corps of Engineers for this dam is as follows: The Beckemeyer Lake Dam has a high hazard potential, meaning that the dam is located where failure may cause loss of life, and serious damage to homes, agricultural, industrial and commercial facilities, and to important public utilities, main highways, or railroads. For the Beckemeyer Lake Dam the estimated flood damage zone extends approximately two miles downstream of the dam. Within the estimated damage zone are four dwellings, two roads including U.S. Route 24 and two trailers. Contents of the estimated damage zone were verified by the inspection team.

e. Ownership. The dam is owned by Howard Beckemeyer, Route 1, Napoleon, Missouri 64074, Telephone 816-934-8254.

f. Purpose of Dam. The dam forms an 8-acre lake used for soil conservation and livestock water supply.

g. Design and Construction History. The Lafayette County Soil Conservation Service provided assistance in the design and construction of the dam. The dam was constructed in 1977.

h. Normal Operating Procedure. Normal rainfall, runoff, withdrawals (pumped) for water supply for livestock operation, transpiration, evaporation, and overflow through the uncontrolled outlet pipe all combine to maintain a relatively stable water surface elevation.

1.3 PERTINENT DATA

a. Drainage Area - 237 acres (includes 90 acres above an upstream impoundment).

b. Discharge at Damsite.

(1) Normal discharge at the damsite is through an uncontrolled 15-inch outlet pipe.

(2) Estimated experienced maximum flood at damsite - The owner Mr. Howard Beckemeyer, stated that a rainfall of approximately 12 inches in 24 hours during September, 19?? did not overtop the dam. Prior to this time the lake was nearly empty.

(3) Estimated ungated spillway capacity at maximum pool elevation 1,050 cfs (50 percent Probable Maximum Flood Pool El. ?56.)

c. Elevation (feet above m.s.l.)

(1) Top of dam - ?53.9 (see Plate 3)

(2) Emergency spillway crest - ?52.6

(3) Primary spillway pipe invert - ?50.0

(4) Streambed at toe of dam - ?23.+

(5) Maximum tailwater - Unknown

d. Reservoir

(1) Length of maximum pool - 2200 feet + (50 percent probable maximum flood pool level)

(2) Length of normal pool - 2000 feet + (Primary spillway pipe invert)

e. Storage (Acre-feet)

(1) Top of dam - 122

(2) Emergency spillway crest - 109

(3) Primary spillway pipe invert - 86

(4) Design surcharge - Not available.

f. Reservoir Surface (Acres)

(1) Top of dam - 11.0

(2) Emergency spillway crest - 10.0.

(3) Primary spillway pipe invert - N/A.

b. Dam

(1) Type - Earth embankment

(2) Length - [illegible] feet

(3) Height - [illegible] feet +

(4) Top width - [illegible] feet

(5) Side slopes - upstream face 3.0 V on 1.0 H, downstream face varies between 3.0 V on 1.0 H and 3.0 V on 3.5 H (see Plate 4

(6) Zoning - Unknown

(7) Impervious core - Unknown

(8) Cutoff - Unknown

(9) Grout curtain - Unknown

h. Diversion and Regulating Tunnel - None

i. Primary Spillway

(1) Type - 15-inch beveled steel pipe with a canopy inlet

(2) Inlet invert elevation - 750.0 feet m.s.l.

(3) Outlet invert elevation - 723.[illegible] feet m.s.l.

(4) Gates - None

(5) Upstream channel - Dead trees stand in the upper end of the lake. The channel is tree lined with another dam upstream

(6) Downstream channel - Natural open channel to streambed

j. Emergency Spillway

(1) Type - Grass open channel

(c) Width of channel - [illegible] feet

(d) Emergency spillway crest - [illegible]

(e) Gates - None

(f) Upstream channel - Not applicable

(g) Downstream channel - Natural open channel to a streambed

(h) Regulating Outlets - Not observed

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Design assistance was provided by the Lafayette County Soil Conservation Service. Design data were unavailable.

2.2 CONSTRUCTION

Construction records were unavailable, however, the dam was constructed in 1977.

2.3 OPERATION

Documentation of past floods was not available. The owner, Mr. Howard Beckemeyer, stated that a rainfall of 12 inches in a 24-hour period in September, 1977 did not overtop the dam but caused erosion in the unlined emergency spillway channel. It should be noted that the dam was just completed and that the lake was nearly empty when the storm occurred.

2.4 GEOLOGY

The site of the dam and reservoir is located in a deeply incised valley between two ridges. The dam impounds a small intermittent tributary of Hicklin Branch.

The soil of the dam and reservoir area consists of the Knox soil series. The Knox series consists of well-drained, loamy soils on ridges and hillsides. These soils formed under deciduous hardwoods in 10 to 90 feet or more of loess. Limestone, shale, or sandstone bedrock occurs beneath the loess. For engineering purposes these soils are classified as low-plastic silt (ML) or low-plastic clay (CL).

The bedrock in the area of the dam and reservoir consists of shale of the Pleasanton Group and interbedded shale, limestone, coal and sandstone of the Marmaton Group.

2.5 EVALUATION

a. Availability. No engineering data could be obtained.

b. Adequacy. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate

loading conditions (including earthquake loads) and made a matter of record.

c. Validity. The validity of the design, construction, and operation could not be determined due to the lack of engineering data.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of Beckemeyer Lake Dam was made on 22 May 1980. The inspection team consisted of Ed Burton, team leader; Bob Pinker, geologist; C.L. Metzler, geotechnical engineer; Mark Snyder, hydraulic engineer; John Ruhl, hydraulic engineer; and Al Reif, structural engineer. Mr. Howard Beckemeyer, the dam owner, was at the site before and after the inspection. The dam is in fair condition. Specific observations are discussed below. No observations were made of the condition of the upstream face of the dam below the pool elevation at the time of the inspection.

b. Dam. The inspection team observed the following conditions at the dam. No cracking, sloughing, sliding, sinkholes, or other signs of settlement were observed. There is no evidence to indicate that the embankment has been overtopped. The embankment has no visible stability problems.

Seepage and resulting erosion was observed at the interface of the embankment and the left abutment. Seepage was also observed downstream of the embankment. The seepage was clear and nonflowing except at the left abutment where the flow was estimated to be 1 gpm. Some erosion has occurred on the downstream face. The material being eroded is a clayey silt (ML). No toe drains or relief wells were observed. The embankment has a good fescue grass cover on the upstream and downstream slopes. This grass has been effective in slowing erosion on the downstream slope but has not curbed erosion in the seepage areas. There are no trees on the embankment. Considerable animal burrowing activity was observed on the upstream slope which indicated the presence of several large colonies. Very few burrows were noted on the downstream slope with some observed on the dam crest.

c. Appurtenant Structures. The inspection team observed the following items pertaining to the appurtenant structures. The primary spillway consists of an uncontrolled 15-inch beveled steel pipe with a canopy inlet which runs through the embankment. About 10-12 feet of the interior of the steel pipe at the outlet end, about 4 feet of the exterior of the pipe at the outlet end, and 2 feet of the pipe at the inlet end were inspected. Minor rust was found on the inside surface. The pipe alignment was observed to follow a vertical curve. No evidence of leakage was noted into, out of or around the spillway pipe. There is some erosion near the outlet end of the primary spillway pipe.

The grass-lined emergency spillway channel was observed to be eroded down the middle. This erosion occurred during the September 1977 flood, prior to establishment of the grass cover, according to the owner, Mr. Howard Beckemeyer. The eroded material is a clayey silt (ML). The emergency spillway contains no obstructions to flow.

d. Geology. The soil in the area of the dam and reservoir is formed in loess of unknown thickness. The soils are classified as low-plastic silt (ML) for engineering purposes. The depth to rock is anticipated to be greater than 10 feet.

One outcrop of bedrock was observed approximately 100 yards downstream of the dam. The rock consisted of weathered shale of the Pleasanton Group. No other outcrops were observed.

Samples of the embankment were taken near the center of the upstream crest using an Oakfield sampler. The materials in the samples were classified as clayey silt (ML) in accordance with ASTM D-2488-69. Based on the samples and visual observation, it is anticipated that the embankment consists of clayey silt (ML).

The abutments and foundation of the dam are anticipated to be clayey silt overlying shale bedrock.

e. Reservoir Area. No slides or excessive erosion due to wave action were observed along the shore of the reservoir. The lake is fairly clear with no noticeable siltation.

f. Downstream Channel. The channel downstream of the spillway outlet pipe is a natural open channel to the original streambed.

3.2 EVALUATION

The various deficiencies observed at the time of the inspection are not believed to represent an immediate safety hazard. They do, however, warrant monitoring and control. The most serious seepage is at the left abutment interface. Seepage can cause internal erosion creating cavities and underground channels, thereby weakening the embankment. The most serious erosion is in the emergency spillway channel and near the seepage at the left abutment. Burrowing animals will continue to damage the embankment if the present animal control program is not expanded sufficiently to eliminate them. Piping failure of the embankment has resulted in similar small earth dams due to burrowing animal damage.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The pool is primarily controlled by rainfall, runoff, withdrawals (pumped) for water supply for livestock operation, evaporation, transpiration, and capacity of the uncontrolled primary spillway outlet pipe.

4.2 MAINTENANCE OF DAM

The existing maintenance program includes occasional mowing of the slopes, reseeding the eroded areas and trapping muskrats in the winter.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities were observed.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no existing warning system or preplanned scheme for alerting downstream residents for this dam.

4.5 EVALUATION

The maintenance program should be expanded to include more frequent mowing of the grass cover on the embankment in order to discourage animal burrowing. The animal control program should be expanded to eliminate the burrowing animals. More extensive measures than reseeding of the eroded areas should be undertaken. The areas of erosion should be repaired prior to reseeding and the seeded areas should be protected until grass cover is established. The areas of seepage should be monitored periodically and, if flows increase significantly or if seepage flows become muddy, a qualified engineer should be consulted.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. Design data pertaining to hydrology and hydraulics were unavailable

b. Experience Data. The drainage area and lake surface area are developed from USGS Bates City Quadrangle Map. The dam layout is from a survey made during the inspection. All elevations are based on an assumed elevation of 750.0 at the primary spillway inlet invert.

c. Visual Observations.

(1) The primary spillway appears to be in good condition. The lake level at the time of the inspection was at the inlet level and there was some flow through the pipe. About 10-12 feet of the interior of the steel pipe at the outlet end, about 4 feet of the exterior of the steel pipe at the outlet end, and 2 feet of the pipe at the inlet end were observed. The spillway pipe discharges with a free outfall into a natural channel. There were no obstructions to flow in the downstream channel.

(2) The emergency spillway channel is eroded.

(3) Emergency spillway discharges can erode the embankment.

d. Overtopping Potential. The spillways were analyzed using the hydrologic and hydraulic methods described in Appendix A. The spillways will not pass the probable maximum flood without overtopping the dam. The probable maximum flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The spillways will pass 10 percent of the probable maximum flood without overtopping the dam. The spillways will not pass the one percent probability flood estimated to have a peak outflow of 212 cfs developed by a 24-hour, one percent probability rainfall. According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, a high hazard dam of small size should pass 50 to 100 percent of the probable maximum flood. Considering the small volume of water impounded by the dam, the valley below the dam and the downstream hazard, the appropriate spillway design flood should be 50 percent of the probable maximum flood. The portion of the estimated peak discharge of the probable maximum flood overtopping the dam would be 2,600 cfs of the total discharge from the reservoir of 4,300 cfs. The estimated duration of overtopping is 8.2 hours with a maximum height of 3.2 feet. The

portion of the estimated peak discharge of 50 percent of the probable maximum flood overtopping the dam would be 850 cfs of the total discharge from the reservoir of 1,900 cfs. The estimated duration of overtopping is 5.8 hours with a maximum height of 2.2 feet. Overtopping of the embankment for these periods of time could jeopardize the embankment.

According to the St. Louis District, Corps of Engineers, the effect from rupture of the dam could extend approximately two miles downstream of the dam. Four dwellings, two roads including U.S. Route 24 and two trailers could be severely damaged and lives could be lost should failure of the dam occur. Contents of the estimated downstream damage zone were verified by the inspection team. There does not appear to be any flood plain regulations or other constraints in force to limit future downstream development.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of conditions which affect the structural stability of this dam are discussed in Section 3, paragraph 3.1b.

b. Design and Construction Data. No design data relating to the structural stability of the dam were found. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Operating Records. No operational records exist.

d. Postconstruction Changes. No changes have been made since completion of the dam.

e. Seismic Stability. The dam is located in Seismic Zone 1 which is a zone of minor seismic risk. A properly designed and constructed earth dam using sound engineering principles and conservation should pose no serious stability problems during earthquakes in this zone. The seismic stability of an earth dam is dependent upon a number of factors: embankment and foundation material classifications and shear strengths; abutment materials, conditions, and strengths; embankment zoning, and embankment geometry. Adequate descriptions of embankment design parameters, foundation and abutment conditions, or static stability analyses to assess the seismic stability of this embankment were not available and therefore no inferences will be made regarding the seismic stability. An assessment of the seismic stability should be included as part of the stability analysis required by the guidelines.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. Several conditions observed during the visual inspection by the inspection team should be monitored and/or controlled These are seepage and the resulting erosion at the interface of the embankment and the left abutment; erosion in the emergency spillway channel; seepage downstream of the dam; and numerous animal burrows, especially on the upstream slope of the dam.

b. Adequacy of Information. Due to the lack of engineering design data, the conclusions in this report were based only on performance history and visual conditions. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency. A program should be developed as soon as possible to monitor at regular intervals the deficiencies described in this report. The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. The item recommended in paragraph 7.2a should be pursued on a high priority basis.

d. Necessity for Phase II. The Phase I investigation does not raise any serious questions relating to the safety of the dam nor does it identify any serious dangers which would require a Phase II investigation. However, the additional analyses noted in paragraph 2.5b are necessary for compliance with the guidelines.

e. Seismic Stability. This dam is located in Seismic Zone 1. Adequate description of embankment design parameters, foundation and abutment conditions, or static stability analyses to assess the seismic stability of this embankment was not available and therefore no inferences will be made regarding the seismic stability. An assessment of the seismic stability should be included as part of the recommended stability analysis.

7.2 REMEDIAL MEASURES

a. Alternatives. The emergency spillway size and/or height of dam would need to be increased or the lake level would need to be lowered to increase available flood storage in order to pass the spillway design flood. The emergency spillway should be protected to prevent erosion.

f. Operation and Maintenance Procedures. The following operation and maintenance procedures should be carried out under the direction of an engineer experienced in the design, construction, and inspection of dams.

(1) The seepage areas noted in section 3.1.b. as a result of the visual inspection should be closely monitored and documented as to quantity of flow.

(2) The animal burrows in the embankment should be repaired since they can lead to piping. Control measures should be implemented to discourage increased animal activity in the area.

(3) The areas of erosion noted in Sections 3.1.b and 3.1.c should be repaired.

(4) An improved maintenance program should be developed. Grass cover on the embankment should be cut more frequently. Frequent observations of the upstream slope should be made to note any evidence of erosion, sloughing, or sliding of embankment material. Should conditions of progressive deterioration be noted, measures should be undertaken to evaluate the adequacy of upstream slope protection and/or the stability of the embankment.

(5) Seepage and stability analyses should be performed.

(6) A detailed inspection of the dam should be made periodically. More frequent inspections may be required if additional deficiencies are observed or the severity of the reported deficiencies increase.

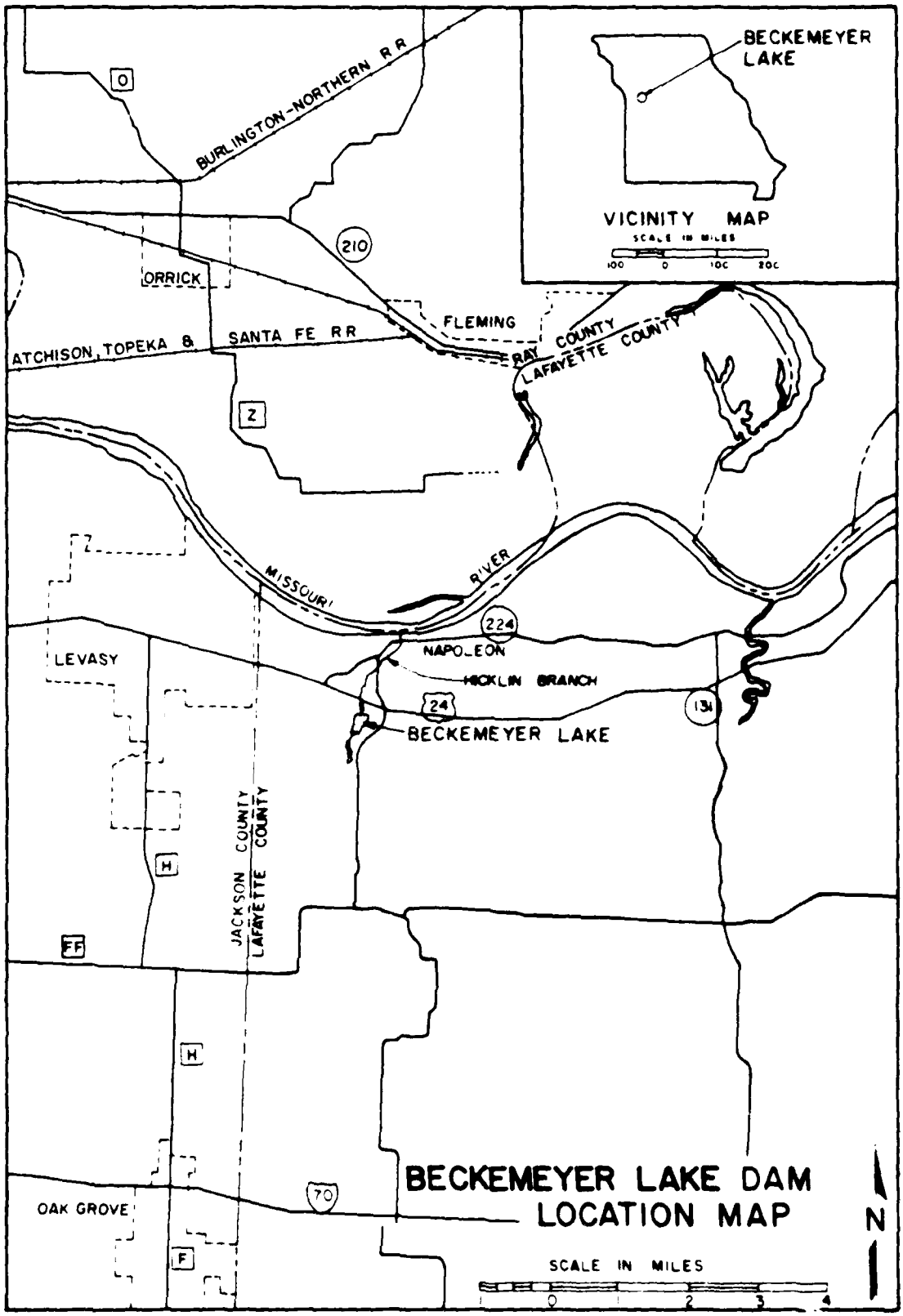

BECKEMEYER LAKE
VICINITY MAP
SCALE IN MILES
100 0 100 200
BURLINGTON-NORTHERN R R
O
210
ORRICK
FLEMING
ATCHISON, TOPEKA & SANTA FE RR
RAY COUNTY
LAFAYETTE COUNTY
Z
MISSOURI RIVER
224
NAPOLEON
HICKLIN BRANCH
24
131
BECKEMEYER LAKE
LEVASY
JACKSON COUNTY
LAFAYETTE COUNTY
H
FF
H
70
OAK GROVE
F
BECKEMEYER LAKE DAM
LOCATION MAP
N
SCALE IN MILES
0 2 3 4

PLATE 1

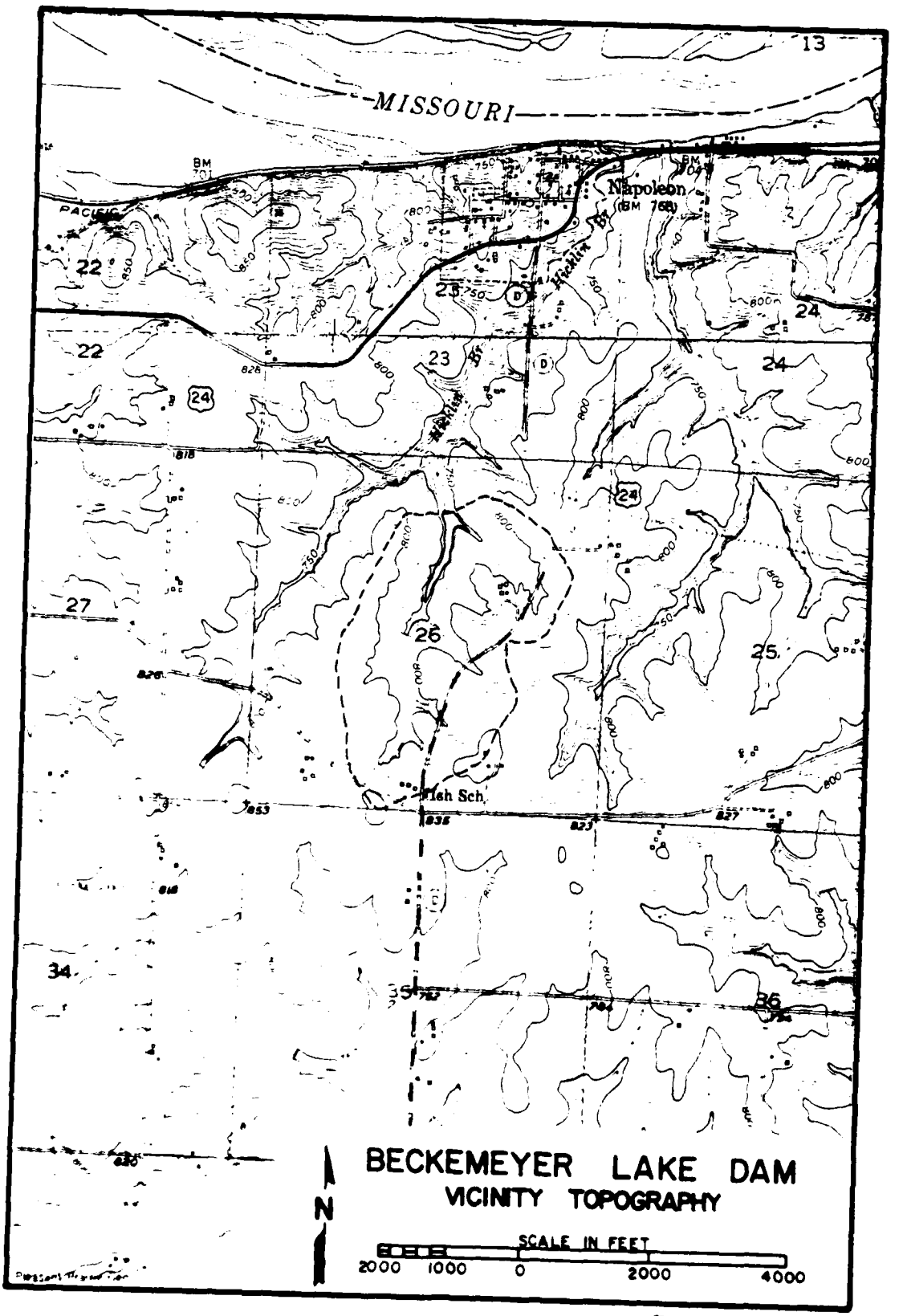
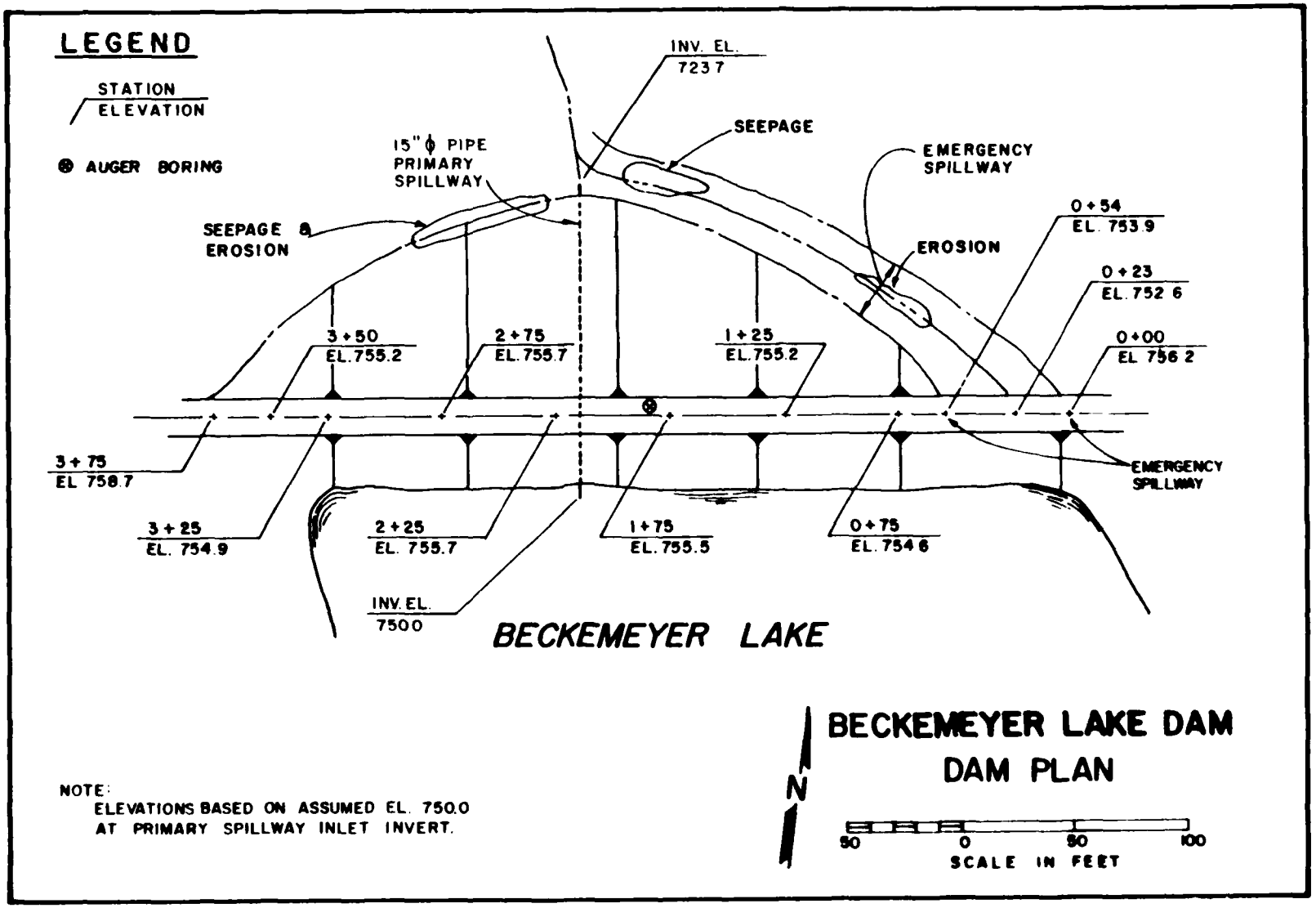

MISSOURI
Napoleon
PACIFIC
Meadow
Fish Sch.
N
BECKEMEYER LAKE DAM
VICINITY TOPOGRAPHY
SCALE IN FEET
2000 1000 0 2000 4000

PLATE 2



NOTE:
ELEVATIONS BASED ON ASSUMED EL. 750.0
AT PRIMARY SPILLWAY INLET INVERT.

PLATE 3

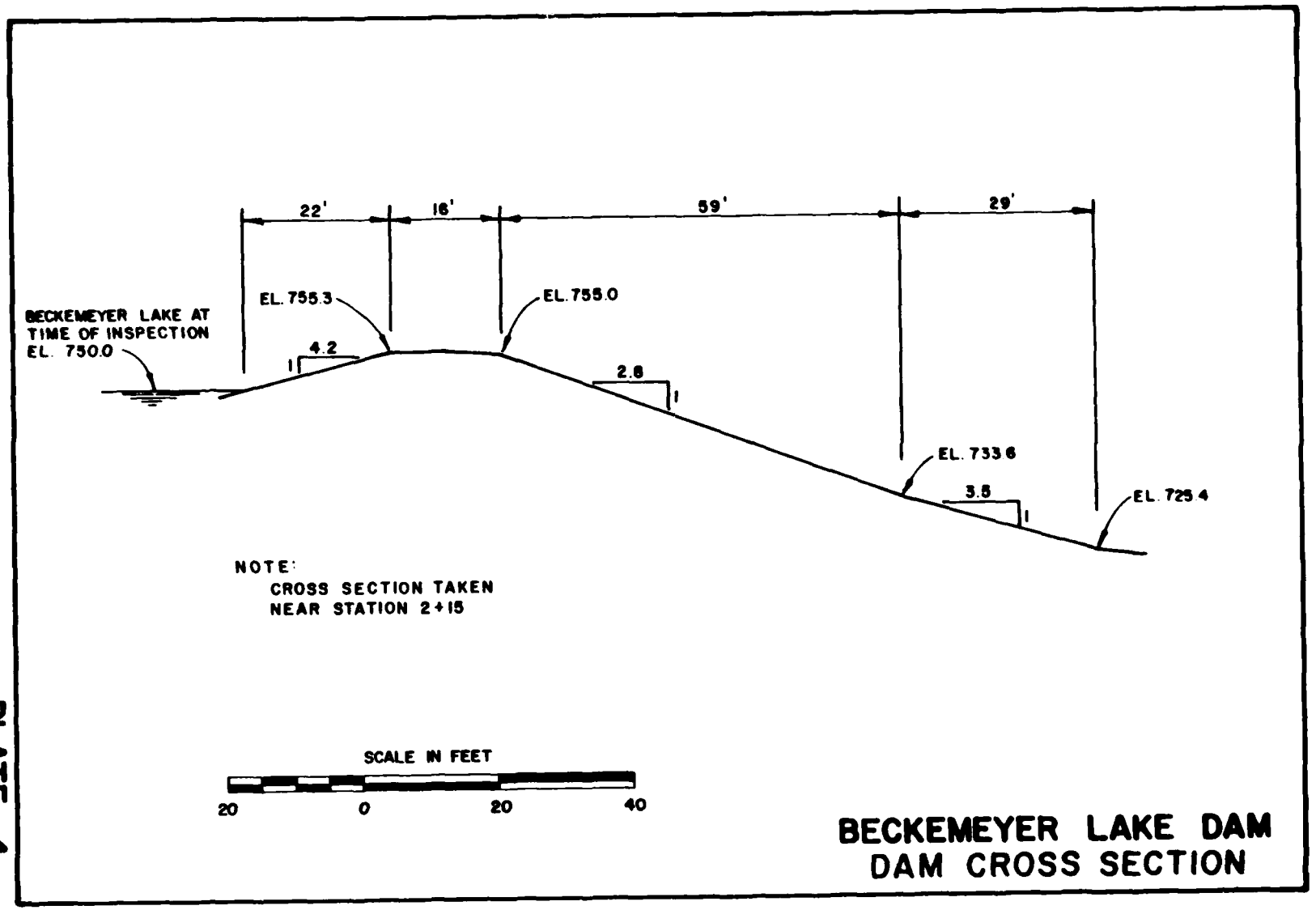
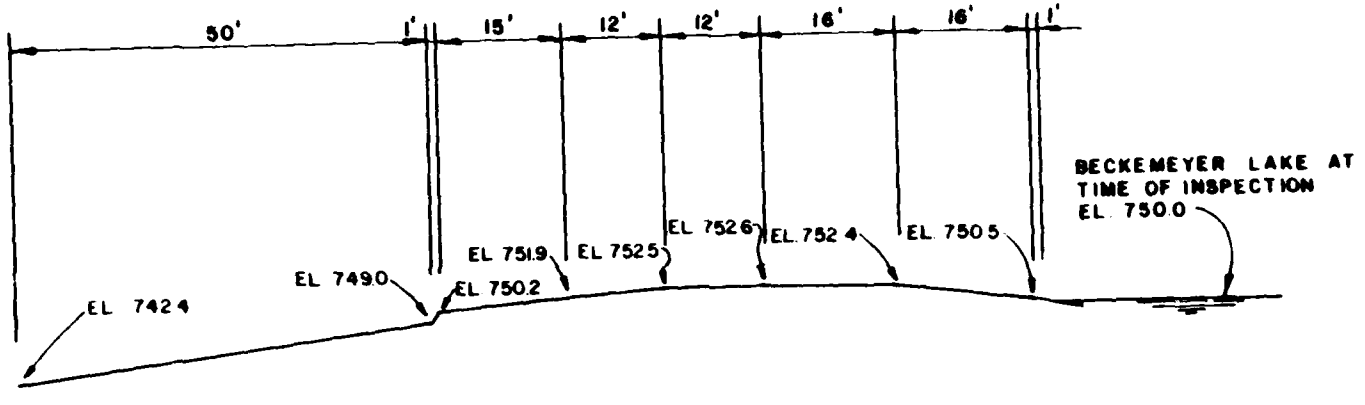

22'
16'
59'
29'
EL. 755.3
EL. 755.0
BECKEMEYER LAKE AT
TIME OF INSPECTION
EL. 750.0
4.2
1
2.8
1
EL. 733.6
3.5
1
EL. 725.4
NOTE:
CROSS SECTION TAKEN
NEAR STATION 2+15
SCALE IN FEET
20
0
20
40
BECKEMEYER LAKE DAM
DAM CROSS SECTION

PLATE 4



NOTE.
PROFILE TAKEN AT FLOWLINE
OF EMERGENCY SPILLWAY.

SCALE IN FEET

20 0 20 40

BECKEMEYER LAKE DAM
EMERGENCY SPILLWAY PROFILE

PLATE 5

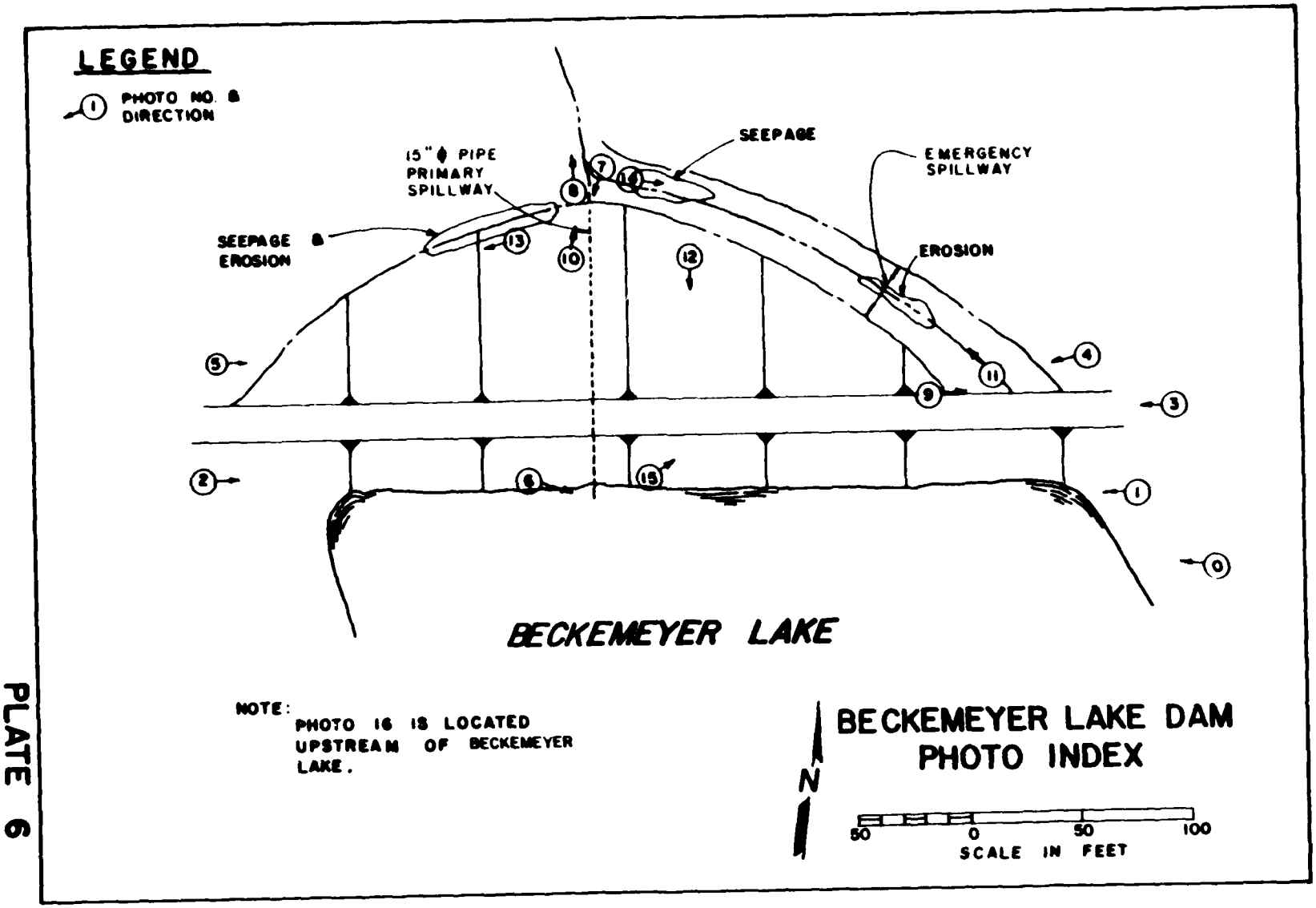

LEGEND
PHOTO NO. & DIRECTION
15" ϕ PIPE PRIMARY SPILLWAY
SEEPAGE
EMERGENCY SPILLWAY
SEEPAGE & EROSION
EROSION
BECKEMEYER LAKE
NOTE: PHOTO 16 IS LOCATED UPSTREAM OF BECKEMEYER LAKE.
N
BECKEMEYER LAKE DAM
PHOTO INDEX
50 0 50 100
SCALE IN FEET

PLATE 6

PHOTO 1: UPSTREAM FACE OF DAM

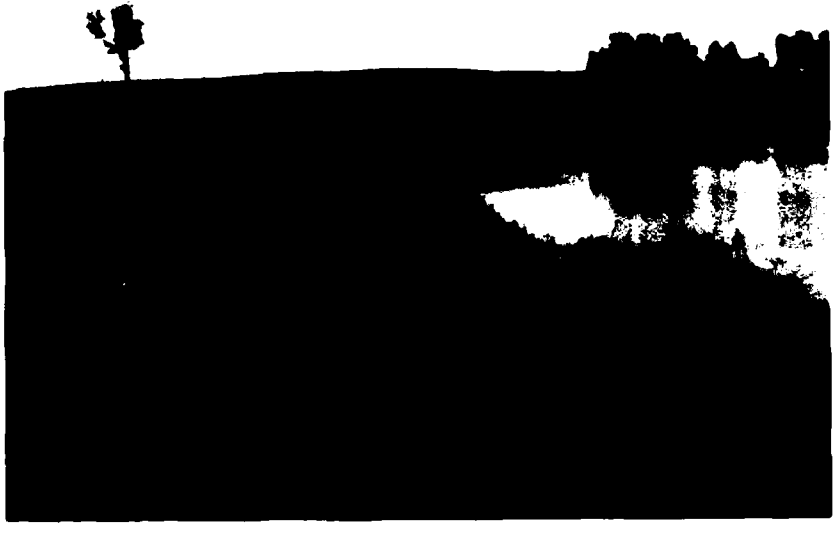


PHOTO 2: UPSTREAM FACE OF DAM LOOKING EAST

PHOTO 3: CREST OF DAM LOOKING WEST

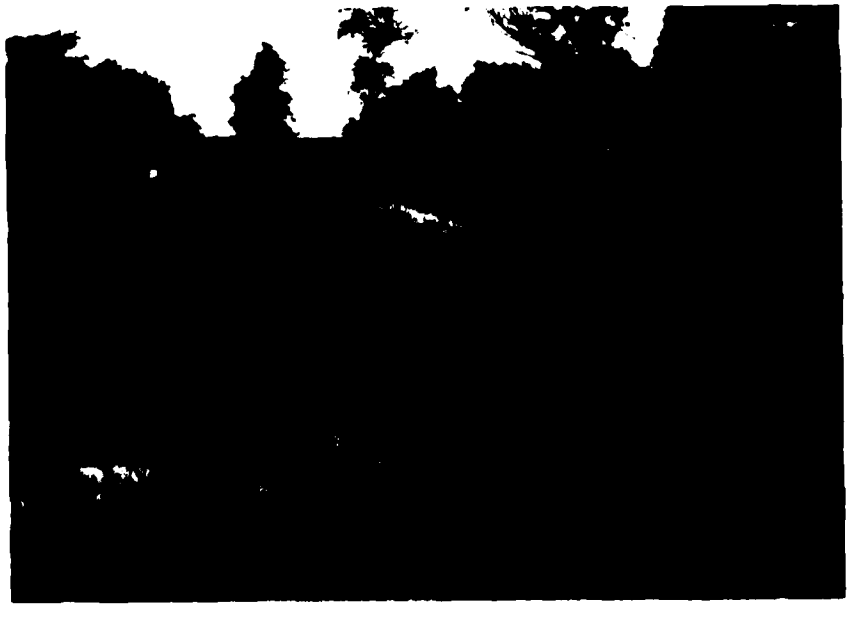


PHOTO 4: DOWNSTREAM SLOPE OF DAM LOOKING WEST

PHOTO 5: DOWNSTREAM SLOPE OF DAM LOOKING EAST

PHOTO 6: PRIMARY SPILLWAY INLET

PHOTO 7: PRIMARY SPILLWAY OUTLET

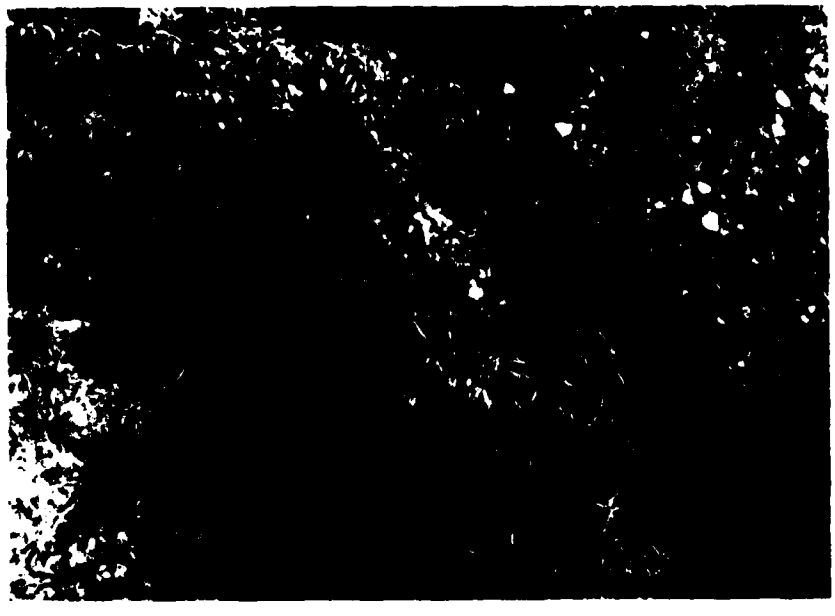


PHOTO 8: CHANNEL BELOW PRIMARY SPILLWAY

PHOTO 9: EMERGENCY SPILLWAY

PHOTO 10: EROSION ALONG PRIMARY SPILLWAY PIPE

PHOTO 11: EROSION IN EMERGENCY SPILLWAY

PHOTO 12: EROSION ON DOWNSTREAM SLOPE OF DAM

PHOTO 13: SEEPAGE AT LEFT ABUTMENT/EMBANKMENT INTERFACE

PHOTO 14: SEEPAGE BELOW TOE OF DAM

PHOTO 15: ANIMAL BURROWS ON FACE OF DAM

PHOTO 16: UPSTREAM DAM

APPENDIX A

HYDROLOGIC AND HYDRAULIC ANALYSES

HYDROLOGIC AND HYDRAULIC ANALYSES

To determine the overtopping potential of *Beckemeyer Lake Dam*, flood routings were performed by applying the Probable Maximum Precipitation (PMP) to synthetic unit hydrographs to develop inflow hydrographs for Beckemeyer Lake and its upstream reservoir. The inflow hydrographs were then routed through the reservoirs and spillways. The overtopping analyses were determined using the computer program HEC-1 (Dam Safety Version) (1).

The PMP was determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33" (HMR-33). Reduction factors were not applied. The rainfall distribution for the 24-hour PMP storm was determined according to the procedures outlined in HMR-33 and EM 1110-2-1411. The Kansas City, Missouri rainfall distribution (5 min. interval - 24 hours duration), as provided by the St. Louis District, Corp of Engineers, was used when the one percent chance probability flood was routed through the reservoirs and spillways.

The synthetic unit hydrographs for the watershed were developed by the computer program using the Soil Converation Service (SCS) method. The parameters for the unit hydrographs are shown in Table 1.

The SCS curve number (CN) method was used in computing the infiltration losses for rainfall-runoff relationships. The CN values used, and the result from the computer output, are shown in Table 2.

Storms were routed through Beckemeyer Lake and the lake upstream of Beckemeyer Lake (see Plate 2) which shall be referenced as "Upstream Lake" through the remainder of this appendix.

Routing through the reservoirs was performed using the Modified Puls Method. The initial reservoir pool elevations for the routing of each storm were determined to be equivalent to the primary spillway crest elevations in accordance with antecedent storm conditions preceding the one percent probability and probable maximum storms outlined by the U.S. Army Corps of Engineers, St. Louis District (5). The hydraulic capacity of the spillways and the storage capacity of the reservoirs were defined by the elevation, surface area, storage, and discharge relationships shown in Table 3.

The rating curves for the spillways are shown in Table 4. The flow over the crest of each of the dams was determined using the nonlevel dam crest option ($L and $V cards) of the HEC-1 program. The program assumes critical flow over a broad-crested weir. The flow through the primary spillways was determined from the orifice flow equation, the weir flow equation, and from Hydraulic Charts for The Selection of Highway Culverts. (7) The flow over the Upstream Lake Dam emergency

spillway was determined from the weir equation. The flow over the Beckemeyer Lake Dam emergency spillway was determined from backwater analysis.

Where routing through the upstream reservoir resulted in overtopping breach, analyses were performed using HEC-1. The breaching parameters are noted in Table 5.

The result of the routing and breach analyses indicates that 10 percent of the PMF will not overtop the Beckemeyer Lake dam.

A summary of the routing analysis for different ratios of the PMF is shown in Table 6.

The computer input data and a summary of the output data are presented at the back of this appendix.

TABLE 1

SYNTHETIC UNIT HYDROGRAPH

Parameters:	Upstream Lake	Beckemeyer Lake
Drainage Area (A)	90 acres	237 acres*
Hydraulic Length of Watercourse (L)	0.22 miles	0.42 miles
Difference in Elevation (H)	85 feet	100 feet
Lag Time (L_g)	0.05 hours	0.1 hours
Time of Concentration (T_c)	0.08 hours	0.16 hours
Duration (D)	1 minute (use 5 minutes in both cases)	1 minute

*Includes the drainage area of Upstream Lake

TABLE 1
(Continued)

Unit Hydrograph Coordinates

Time (Min)	Discharge (cfs)*	
	Upstream-Lake	Beckemeyer Lake
0	0	0
5	724	503
10	277	745
15	64	327
20	15	127
25	3	49
30		19
35		8
40		2

*From HEC-1 computer output

FORMULAS USED:

$$T_c = [(11.9 \times L^3)/H]^{0.385}$$

$$Lg = 0.6\ Tc$$

$$D = 0.133\ T_c$$

TABLE 2

RAINFALL-RUNOFF VALUES

Selected Storm Event	Storm Duration (Hours)	Rainfall (Inches)	Runoff (Inches)	Loss (Inches)
PMF				
Upstream Lake	24	31.98	30.40	1.58
Beckemeyer Lake	24	31.98	30.40	1.58
50% PMF				
Upstream Lake	24	16.73	15.20	1.53
Beckemeyer Lake	24	16.73	15.20	1.53
1% Probability				
Upstream Lake	24	7.59	4.68	2.92
Beckemeyer Lake	24	7.59	4.56	3.03

Additional Data:

1) The soil associations in this watershed are Marshall, Knox, and Higginsville (3).
   98 percent of total drainage area in hydrologic soil group B.
   2 percent of total drainage area in hydrologic soil group C.
   92 percent of the land use was cropland.
   8 percent of the land use was timberland (2 and 4).
2) SCS Runoff Curve CN (AMC III) for ratios of the PMF:
   88 - Upstream Lake
   88 - Beckemeyer Lake
3) SCS Runoff Curve CN (AMC II) for the one percent probability flood:
   75 - Upstream Lake
   74 - Beckemeyer Lake

TABLE 3

ELEVATION, SURFACE AREA, STORAGE, AND DISCHARGE RELATIONSHIPS

Elevation (feet-MSL)	Lake Surface Area (acres)	Lake Storage (acre-ft)	Spillway Discharge (cfs)
Upstream Lake			
*769.1	4.3	40	0
**771.0	4.8	49	74
***773.2	5.4	60	314
Beckemeyer Lake			
*750.0	8.1	86	0
**752.6	10.0	109	9
***753.9	11.0	122	154

*Primary spillway crest elevation
**Emergency spillway crest elevation
***Top of dam elevation

The relationships in Table 3 were developed from the Bates City, Missouri 7.5 minute quadrangle map and the field measurements.

TABLE 4

SPILLWAY RATING CURVE

Reservoir Elevation (ft-msl)	Primary Spillway Discharge (cfs)	Emergency Spillway Discharge (cfs)	Total Spillway Discharges (cfs)
		Upstream Lake	
769.0	0	0	0
770.0	26	0	26
*771.0	74	0	74
772.0	108	26	134
773.0	112	142	254
**773.2	114	200	314
774.0	120	431	551
775.0	122	783	905
		Beckemeyer Lake	
750.0	0	0	0
751.0	3	0	3
752.0	7	0	7
*752.6	9	0	9
753.0	10	20	30
754.0	12	156	168
755.0	14	470	484
757.0	17	1,600	***1,620
760.0	21	4,130	***4,150

*Emergency Spillway Crest Elevation
**Top of Dam Elevation
***Values rounded off

METHOD USED

Upstream Lake

Primary spillway releases were calculated using the weir and orifice equations. The weir equation for the drop inlet is:

$$Q = CLH^{3/2}$$

where:

C = 3.3 = coefficient of discharge; inlet acts as a sharp-crested weir,
L = 7.85 ft. = length of the weir = circumference of pipe
H = head in feet

Orifice equation (6):

$$Q = C_a[2gH]^{1/2}$$

where

C = 0.6 = coefficient of discharge
a = 4.9 sq. ft. = area of orifice
g = 32.2 ft/sec^2 = acceleration due to gravity
H = difference between the energy gradient elevation upstream and the downstream tailwater elevation

Emergency spillway releases were computed using the equations for flow over nonlevel crests:

$$d_c = 2/3\ (H_m + 1/4\ \Delta Y)$$

$$A = 1/2\ T\ (2d_c - \Delta Y)$$

$$Q = (A^3 g/T)^{0.5}$$

where:

d_c = critical depth (feet)
H_m = available specific energy which is taken to be the height of the water surface in the reservoir above the bottom of the section (feet)
ΔY = change in elevation across the section (feet)
A = flow area (sq. ft.)
T = top width (feet)
Q = flow (cfs)
g = 32.2 ft/sec^2 = acceleration due to gravity.

Beckemeyer Lake

Primary spillway releases were determined by nomographs for steel pipe (7).

Emergency spillway releases were determined from backwater analysis of the spillway channel.

TABLE 5

BREACHING PARAMETERS

	Upstream Lake
Bottom Width of Breach (BRWID)	10 feet
Side Slope of Breach (z) (In feet horizontal to 1.0 feet vertical)	0.5
Elevation of Breach Bottom at Maximum Size of Breach (ELBM)	757.0 ft. m.s.l.
Time for Breach to Develop to Maximum Size (TFAIL)	1.0 hour
Elevation of Water Surface Which Will Cause Dam to Fail (FAILEL)	773.2 ft. m.s.l.

TABLE 6

RESULTS OF FLOOD ROUTINGS - BECKEMEYER LAKE

Ratio of PMF	Peak Inflow (CFS)	Peak Lake Elevation (ft.-MSL)	Total Storage (AC.-FT.)	Peak Outflow (CFS)	Depth (ft.) Over Top of Dam
-	0	*750.0	86	0	-
0.10	556	753.5	118	99	0
0.50	2,327	756.1	147	1,903	2.2
1.00	4,796	757.1	161	4,303	3.2

* Primary spillway crest elevation.

BIBLIOGRAPHY

(1) U.S. Army Corps of Engineers, Hydrologic Engineering Center, Flood Hydrograph Package (HEC-1), Dam Safety Version, July 1978, Davis, California.

(2) U.S. Department of Agriculture, Soil Conservation Service, Technical Release No. 55, Urban Hydrology for Small Watersheds, January, 1975.

(3) U.S. Department of Agriculture, Soil Conservation Service, Preliminary Soils Report for Lafayette County, Missouri.

(4) U.S. Department of Agriculture, Soil Conservation Service, National Engineering Handbook, Section 4, Hydrology, August 1972.

(5) U.S. Army Corps of Engineers, St. Louis District, Hydrologic/ Hydraulic Standards, Phase I Safety Inspection of Non-Federal Dams, 12 December 1979.

(6) Horace W. King and Ernest F. Brater, Handbook of Hydraulics, Sixth Edition, McGraw Hill Book Company, 1976.

(7) U.S. Department of Commerce, Bureau of Public Roads, Hydraulic Engineering Circular No. 5, Hydraulic Charts for the Selection of Highway Culverts, December, 1965.

(8) U.S. Department of the Interior, Bureau of Reclamation, Design of Small Dams, 1974, Washington, D.C.

(9) U.S. Department of Agriculture, Soil Conservation Service, Soil Survey Interpretations and Field Maps, 1980.

(10) Mary H. McCracken, Missouri Division of Geological Survey, Geologic Map of Missouri, 1961.

FLOOD HYDROGRAPH PACKAGE - HEC-1 PROGRAM H21/02-00 TIME 10:22:06 CASE

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION  JULY 1978
 LAST MODIFICATION  05 FEB 80
**********
     1              A1       ***********DAM INSPECTIONS
     2              A2       - BECKEMEYER LAKE
     3              A3       PMF AND RATIOS
     4              N    295         0         5         0         0         0         0         0         0         0         0
     5              B1       5
     6              J        1         5         1
     7              J10.1    0.15      0.2       0.5       1.0
     8                         OVERHEAD                                3         1
     9              K1       RUNOFF INTO UPSTREAM RESERVOIR
    10              M        1        20.14                    1.
    11              P        24.6      101.      120.      130.
    12              T                                                  -1       -88
    13              M2       0.05
    14              Y                  1.
    15              K        1   USDAM                                 3         1
    16              K1       ROUTE THROUGH UPSTREAM RESERVOIR
    17              Y                                    1         1
    18              Y1       1                                        -769.1              -1
    19              Y4749.   769.      770.      771.      772.      773.      774.      775.      780.      785.
    20              Y56.     0.        26.       74.       134.      254.      551.      905.      4175.     8816.
    21              SA0.     0.9       1.8       4.5       7.2       12.6
    22              SE749.   750.      760.      770.      780.      790.
    23              $S769.1
    24              $S773.2
    25              SL0.     65.       100.      134.      150.
    26              SV773.1  773.4     773.7     774.      775.
    27              SQ10.    0.5       757.      1.        769.1     773.2
    28              K           OVERHEAD                                3         1
    29              K1       LOCAL RUNOFF INTO BECKMEYER LAKE
    30              M        1        20.23                    1.
    31              P        24.6      101.      120.      130.
    32              T                                                  -1       -88
    33              M2       0.1
    34              Y                  1.
    35              K        1                                         3         1
    36              K1       COMBINE OUTFLOW FROM US DAM AND UNREGULATED INFLOW
    37              K        1   DAM                                   3         1
    38              K1       ROUTE THROUGH BECKEMEYER DAM
    39              Y                                    1         1
    40              Y1       1                                        -750.               -1
    41              Y4750.   752.      753.      754.      755.      756.      757.      760.      762.
    42              Y56.     7.        33.       168.      484.      976.      1620.     4150.     8520.
    43              SA0.     1.1       2.5       4.1       15.3      25.6
    44              SE749.   750.      760.      770.      780.      790.
    45              $S750.
    46              $Q753.9
    47              SL0.     9.        71.       140.      300.      309.      321.      321.
    48              SV751.3  754.      755.      755.3     755.8     757.      759.      765.
    49              ZZ
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT LSTHEAD
ROUTE HYDROGRAPH TO USCAN
RUNOFF HYDROGRAPH AT RMNEAN
COMBINE 2 OF THE PATHS AT
ROUTE HYDROGRAPH TO DOWN
END OF NETWORK

FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 80

PRESSURE DAM INSPECTIONS
RED RIVER LAKE
RMP AND RATIOS

JOB SPECIFICATION

NQ	NRUN	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
.RE	5	5	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1

RTIOS=	.10	.15	.20	.50	1.00

SUB-AREA RUNOFF COMPUTATION

RUNOFF INTO UPSTREAM RESERVOIR

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
USHEAD	0	0	0	3	1	0	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.14	.00	.14	1.00	.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
.00	24.60	101.00	120.00	120.00	.00	.00	.00

LOSS DATA

LKCPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	.00	.00	1.00	.00	.00	1.00	-1.00	-88.00	.00	.00

CURVE NO = -88.00 METNFSS = -1.00 EFFECT CN = 88.00

UNIT HYDROGRAPH DATA
TC= .00 LAG= .05

RECESSION DATA
STRTQ= .00 QRCSN= .00 RTIOR= 1.00

TIME INCREMENT TOO LARGE--(MMG IS GT LAG/2)

UNIT HYDROGRAPH 5 END OF PERIOD ORDINATES, TC= .00 HOURS, LAG= .05 VOL= 1.00

774.	277.	64.	15.	3.

TIME INCREMENT TOO LARGE--KNOW IS OF LAG/2)

UNIT HYDROGRAPH 5 END OF PERIOD ORDINATES, ICT= .00 HOURS, LAG= .05 VOL= 1.00

724. 274. 84. 35. 3.

FLOOD HYDROGRAPH PACKAGE - HEC-1 PROGRAM H21/02-00 TIME 19:22:06 CASE

	END-OF-PERIOD FLOW											
J HO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	HO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	.00	.01	0.	1.01	12.05	145	.21	.20	.01	166.
1.01	.10	2	.01	.00	.01	0.	1.01	12.10	146	.21	.20	.01	205.
1.01	.15	3	.01	.00	.01	0.	1.01	12.15	147	.21	.20	.01	214.
1.01	.20	4	.01	.00	.01	0.	1.01	12.20	148	.21	.20	.01	216.
1.01	.25	5	.01	.00	.01	0.	1.01	12.25	149	.21	.20	.01	217.
1.01	.30	6	.01	.00	.01	0.	1.01	12.30	150	.21	.20	.01	217.
1.01	.35	7	.01	.00	.01	0.	1.01	12.35	151	.21	.20	.01	218.
1.01	.40	8	.01	.00	.01	0.	1.01	12.40	152	.21	.20	.01	218.
1.01	.45	9	.01	.00	.01	0.	1.01	12.45	153	.21	.20	.01	218.
1.01	.50	10	.01	.00	.01	0.	1.01	12.50	154	.21	.20	.01	219.
1.01	.55	11	.01	.00	.01	0.	1.01	12.55	155	.21	.20	.00	219.
1.01	1.00	12	.01	.00	.01	0.	1.01	13.00	156	.21	.20	.00	219.
1.01	1.05	13	.01	.00	.01	0.	1.01	13.05	157	.25	.24	.01	249.
1.01	1.10	14	.01	.00	.01	0.	1.01	13.10	158	.25	.24	.01	260.
1.01	1.15	15	.01	.00	.01	0.	1.01	13.15	159	.25	.24	.00	263.
1.01	1.20	16	.01	.00	.01	0.	1.01	13.20	160	.25	.24	.00	264.
1.01	1.25	17	.01	.00	.01	0.	1.01	13.25	161	.25	.24	.00	264.
1.01	1.30	18	.01	.00	.01	0.	1.01	13.30	162	.25	.24	.00	265.
1.01	1.35	19	.01	.00	.01	0.	1.01	13.35	163	.25	.24	.00	265.
1.01	1.40	20	.01	.00	.01	0.	1.01	13.40	164	.25	.24	.00	265.
1.01	1.45	21	.01	.00	.01	0.	1.01	13.45	165	.25	.24	.00	265.
1.01	1.50	22	.01	.00	.01	0.	1.01	13.50	166	.25	.25	.00	265.
1.01	1.55	23	.01	.00	.01	1.	1.01	13.55	167	.25	.25	.00	266.
1.01	2.00	24	.01	.00	.01	1.	1.01	14.00	168	.25	.25	.00	266.
1.01	2.05	25	.01	.00	.01	1.	1.01	14.05	169	.31	.31	.00	330.
1.01	2.10	26	.01	.00	.01	1.	1.01	14.10	170	.31	.31	.00	332.
1.01	2.15	27	.01	.00	.01	2.	1.01	14.15	171	.31	.31	.00	332.
1.01	2.20	28	.01	.00	.01	2.	1.01	14.20	172	.31	.31	.00	333.
1.01	2.25	29	.01	.00	.01	2.	1.01	14.25	173	.31	.31	.00	333.
1.01	2.30	30	.01	.00	.01	2.	1.01	14.30	174	.31	.31	.00	333.
1.01	2.35	31	.01	.00	.01	3.	1.01	14.35	175	.31	.31	.00	333.
1.01	2.40	32	.01	.00	.01	3.	1.01	14.40	176	.31	.31	.00	334.
1.01	2.45	33	.01	.00	.01	3.	1.01	14.45	177	.31	.31	.00	334.
1.01	2.50	34	.01	.00	.01	3.	1.01	14.50	178	.31	.31	.00	334.
1.01	2.55	35	.01	.00	.01	3.	1.01	14.55	179	.31	.31	.00	334.
1.01	3.00	36	.01	.00	.01	4.	1.01	15.00	180	.31	.31	.00	334.
1.01	3.05	37	.01	.00	.01	4.	1.01	15.05	181	.19	.19	.00	247.
1.01	3.10	38	.01	.00	.01	4.	1.01	15.10	182	.38	.38	.00	349.
1.01	3.15	39	.01	.00	.01	4.	1.01	15.15	183	.38	.38	.00	393.
1.01	3.20	40	.01	.00	.01	4.	1.01	15.20	184	.57	.56	.00	540.
1.01	3.25	41	.01	.00	.01	5.	1.01	15.25	185	.66	.66	.00	662.
1.01	3.30	42	.01	.00	.01	5.	1.01	15.30	186	1.61	1.60	.01	1382.
1.01	3.35	43	.01	.00	.01	5.	1.01	15.35	187	2.64	2.63	.01	2401.
1.01	3.40	44	.01	.00	.01	5.	1.01	15.40	188	1.04	1.03	.00	1591.
1.01	3.45	45	.01	.00	.01	5.	1.01	15.45	189	.66	.66	.00	959.
1.01	3.50	46	.01	.01	.01	5.	1.01	15.50	190	.57	.56	.00	762.
1.01	3.55	47	.01	.01	.01	6.	1.01	15.55	191	.38	.38	.00	495.
1.01	4.00	48	.01	.01	.01	6.	1.01	16.00	192	.38	.38	.00	426.
1.01	4.05	49	.01	.01	.01	6.	1.01	16.05	193	.29	.29	.00	348.
1.01	4.10	50	.01	.01	.01	6.	1.01	16.10	194	.29	.29	.00	341.
1.01	4.15	51	.01	.01	.01	6.	1.01	16.15	195	.29	.29	.00	315.
1.01	4.20	52	.01	.01	.01	6.	1.01	16.20	196	.29	.29	.00	314.
1.01	4.25	53	.01	.01	.01	6.	1.01	16.25	197	.29	.29	.00	313.

1.01	4.30	50	.01	.01	.01	4.	1.01	16.05	194	.29	.29	.00	313.
1.01	4.35	51	.01	.01	.01	4.	1.01	16.10	194	.29	.29	.00	313.
1.	4.35	51	.01	.01	.01	6.	1.01	16.15	195	.29	.29	.00	313.
1.	4.20	52	.01	.01	.01	6.	1.01	16.20	196	.29	.29	.00	314.
1.01	4.25	53	.01	.01	.01	6.	1.01	16.25	197	.29	.29	.00	313.

1.01	4.30	54	.01	.01	.01	5.	1.01	16.30	199	.29	.29	.00	313.
1.01	4.35	55	.01	.01	.01	7.	1.01	16.35	199	.29	.29	.00	313.
1.01	4.40	56	.01	.01	.01	7.	1.01	16.40	200	.29	.29	.00	313.
1.01	4.45	57	.01	.01	.01	7.	1.01	16.45	201	.29	.29	.00	313.
1.01	4.50	58	.01	.01	.01	7.	1.01	16.50	202	.29	.29	.00	313.
1.01	4.55	59	.01	.01	.01	7.	1.01	16.55	203	.29	.29	.00	313.
1.01	5.00	60	.01	.01	.01	7.	1.01	17.00	204	.29	.29	.00	313.
1.01	5.05	61	.01	.01	.01	7.	1.01	17.05	205	.23	.23	.00	269.
1.01	5.10	62	.01	.01	.01	7.	1.01	17.10	206	.23	.23	.00	251.
1.01	5.15	63	.01	.01	.01	7.	1.01	17.15	207	.23	.23	.00	247.
1.01	5.20	64	.01	.01	.01	8.	1.01	17.20	208	.23	.23	.00	246.
1.01	5.25	65	.01	.01	.01	8.	1.01	17.25	209	.23	.23	.00	246.
1.01	5.30	66	.01	.01	.01	8.	1.01	17.30	210	.23	.23	.00	246.
1.01	5.35	67	.01	.01	.01	8.	1.01	17.35	211	.23	.23	.00	246.
1.01	5.40	68	.01	.01	.01	8.	1.01	17.40	212	.23	.23	.00	246.
1.01	5.45	69	.01	.01	.01	8.	1.01	17.45	213	.23	.23	.00	246.
1.01	5.50	70	.01	.01	.01	8.	1.01	17.50	214	.23	.23	.00	246.
1.01	5.55	71	.01	.01	.01	8.	1.01	17.55	215	.23	.23	.00	246.
1.01	6.00	72	.01	.01	.01	8.	1.01	18.00	216	.23	.23	.00	246.
1.01	6.05	73	.04	.04	.03	30.	1.01	18.05	217	.02	.02	.00	40.
1.01	6.10	74	.04	.04	.03	40.	1.01	18.10	218	.02	.02	.00	39.
1.01	6.15	75	.04	.04	.02	43.	1.01	18.15	219	.02	.02	.00	26.
1.01	6.20	76	.04	.04	.02	45.	1.01	18.20	220	.02	.02	.00	23.
1.01	6.25	77	.04	.04	.02	45.	1.01	18.25	221	.02	.02	.00	22.
1.01	6.30	78	.04	.04	.02	48.	1.01	18.30	222	.02	.02	.00	22.
1.01	6.35	79	.04	.05	.02	49.	1.01	18.35	223	.02	.02	.00	22.
1.01	6.40	80	.04	.05	.02	50.	1.01	18.40	224	.02	.02	.00	22.
1.01	6.45	81	.05	.05	.02	51.	1.01	18.45	225	.02	.02	.00	22.
1.01	6.50	82	.05	.05	.02	52.	1.01	18.50	226	.02	.02	.00	22.
1.01	6.55	83	.05	.05	.02	53.	1.01	18.55	227	.02	.02	.00	22.
1.01	7.00	84	.05	.05	.02	54.	1.01	19.00	228	.02	.02	.00	22.
1.01	7.05	85	.06	.05	.01	54.	1.01	19.05	229	.02	.02	.00	22.
1.01	7.10	86	.06	.05	.01	55.	1.01	19.10	230	.02	.02	.00	22.
1.01	7.15	87	.06	.05	.01	56.	1.01	19.15	231	.02	.02	.00	22.
1.01	7.20	88	.06	.05	.01	56.	1.01	19.20	232	.02	.02	.00	22.
1.01	7.25	89	.06	.05	.01	57.	1.01	19.25	233	.02	.02	.00	22.
1.01	7.30	90	.06	.05	.01	57.	1.01	19.30	234	.02	.02	.00	22.
1.01	7.35	91	.06	.05	.01	58.	1.01	19.35	235	.02	.02	.00	22.
1.01	7.40	92	.06	.05	.01	58.	1.01	19.40	236	.02	.02	.00	22.
1.01	7.45	93	.06	.05	.01	59.	1.01	19.45	237	.02	.02	.00	22.
1.01	7.50	94	.06	.05	.01	59.	1.01	19.50	238	.02	.02	.00	22.
1.01	7.55	95	.06	.06	.01	60.	1.01	19.55	239	.02	.02	.00	22.
1.01	8.00	96	.06	.06	.01	60.	1.01	20.00	240	.02	.02	.00	22.
1.01	8.05	97	.06	.06	.01	60.	1.01	20.05	241	.02	.02	.00	22.
1.01	8.10	98	.06	.06	.01	61.	1.01	20.10	242	.02	.02	.00	22.
1.01	8.15	99	.06	.06	.01	61.	1.01	20.15	243	.02	.02	.00	22.
1.01	8.20	100	.06	.06	.01	61.	1.01	20.20	244	.02	.02	.00	22.
1.01	8.25	101	.06	.06	.01	62.	1.01	20.25	245	.02	.02	.00	22.
1.01	8.30	102	.06	.06	.01	62.	1.01	20.30	246	.02	.02	.00	22.
1.01	8.35	103	.06	.06	.01	62.	1.01	20.35	247	.02	.02	.00	22.
1.01	8.40	104	.06	.06	.01	63.	1.01	20.40	248	.02	.02	.00	22.
1.01	8.45	105	.06	.06	.01	63.	1.01	20.45	249	.02	.02	.00	22.
1.01	8.50	106	.06	.06	.01	63.	1.01	20.50	250	.02	.02	.00	22.
1.01	8.55	107	.06	.06	.01	63.	1.01	20.55	251	.02	.02	.00	22.
1.01	9.00	108	.06	.06	.01	63.	1.01	21.00	252	.02	.02	.00	22.
1.01	9.05	109	.06	.06	.01	64.	1.01	21.05	253	.02	.02	.00	22.

[illegible]													
[illegible]													
[illegible]													
1.01	9.00	108	.06	.06	.01	63.	1.01	20.50	250	.02	.02	.00	22.
1.01	9.05	109	.06	.06	.01	64.	1.01	20.55	251	.02	.02	.00	22.
1.01	9.10	110	.06	.06	.01	64.	1.01	21.00	252	.02	.02	.00	22.
1.01	9.15	111	.06	.06	.01	64.	1.01	21.05	253	.02	.02	.00	22.

1.01	9.20	112	.06	.06	.01	64.	1.01	21.10	254	.02	.02	.00	22.
1.01	9.25	113	.06	.06	.01	64.	1.01	21.15	255	.02	.02	.00	22.
1.01	9.30	114	.06	.06	.01	64.	1.01	21.20	256	.02	.02	.00	22.
1.01	9.35	115	.06	.06	.01	64.	1.01	21.25	257	.02	.02	.00	22.
1.01	9.40	116	.06	.06	.01	65.	1.01	21.30	258	.02	.02	.00	22.
1.01	9.45	117	.06	.06	.01	65.	1.01	21.35	259	.02	.02	.00	22.
1.01	9.50	118	.06	.06	.01	65.	1.01	21.40	260	.02	.02	.00	22.
1.01	9.55	119	.06	.06	.00	65.	1.01	21.45	261	.02	.02	.00	22.
1.01	10.00	120	.06	.06	.00	65.	1.01	21.50	262	.02	.02	.00	22.
1.01	10.05	121	.06	.06	.00	65.	1.01	21.55	263	.02	.02	.00	22.
1.01	10.10	122	.06	.06	.00	65.	1.01	22.00	264	.02	.02	.00	22.
1.01	10.15	123	.06	.06	.00	65.	1.01	22.05	265	.02	.02	.00	22.
1.01	10.20	124	.06	.06	.00	65.	1.01	22.10	266	.02	.02	.00	22.
1.01	10.25	125	.06	.06	.00	66.	1.01	22.15	267	.02	.02	.00	22.
1.01	10.30	126	.06	.06	.00	66.	1.01	22.20	268	.02	.02	.00	22.
1.01	10.35	127	.06	.06	.00	66.	1.01	22.25	269	.02	.02	.00	22.
1.01	10.40	128	.06	.06	.00	66.	1.01	22.30	270	.02	.02	.00	22.
1.01	10.45	129	.06	.06	.00	66.	1.01	22.35	271	.02	.02	.00	22.
1.01	10.50	130	.06	.06	.00	66.	1.01	22.40	272	.02	.02	.00	22.
1.01	10.55	131	.06	.06	.00	67.	1.01	22.45	273	.02	.02	.00	22.
1.01	11.00	132	.06	.06	.00	67.	1.01	22.50	274	.02	.02	.00	22.
1.01	11.05	133	.06	.06	.00	67.	1.01	22.55	275	.02	.02	.00	22.
1.01	11.10	134	.06	.06	.00	67.	1.01	23.00	276	.02	.02	.00	22.
1.01	11.15	135	.06	.06	.00	67.	1.01	23.05	277	.02	.02	.00	22.
1.01	11.20	136	.06	.06	.00	67.	1.01	23.10	278	.02	.02	.00	22.
1.01	11.25	137	.06	.06	.00	67.	1.01	23.15	279	.02	.02	.00	22.
1.01	11.30	138	.06	.06	.00	67.	1.01	23.20	280	.02	.02	.00	22.
1.01	11.35	139	.06	.06	.00	67.	1.01	23.25	281	.02	.02	.00	22.
1.01	11.40	140	.06	.06	.00	67.	1.01	23.30	282	.02	.02	.00	22.
1.01	11.45	141	.06	.06	.00	67.	1.01	23.35	283	.02	.02	.00	22.
1.01	11.50	142	.06	.06	.00	67.	1.01	23.40	284	.02	.02	.00	22.
1.01	11.55	143	.06	.06	.00	67.	1.01	23.45	285	.02	.02	.00	22.
1.01	12.00	144	.06	.06	.00	67.	1.01	23.50	286	.02	.02	.00	22.
							1.01	23.55	287	.02	.02	.00	22.
							1.01	.00	288	.02	.02	.00	22.
							SUM	11.98	30.40	1.55		32913.	
								(312.3(	772.3(	40.3(		932.9(	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2401.	369.	114.	114.	32921.
CMS	68.	10.	3.	3.	932.
INCHES		24.53	30.38	30.38	30.38
MM		622.98	771.67	771.67	771.67
AC-FT		183.	227.	227.	227.
THOUS CU M		226.	280.	280.	280.

HYDROGRAPH AT STAUSHEAD FOR PLAN 1, RATIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	240.	37.	11.	11.	3292.
CMS	7.	1.	0.	0.	93.
INCHES		2.45	3.04	3.04	3.04
MM		62.30	77.17	77.17	77.17

HYDROGRAPH ROUTING

ROUTE THROUGH UPSTREAM RESERVOIR

ISTAT	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
USDAM	1	0	0	0	3	1	0	0

ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
.0	.000	.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	.0.0	.0.0	.000	-769.	-1

STAGE	769.00	769.00	770.00	771.00	772.00	773.00	774.00	775.00	780.00	785.00
FLOW	.00	.00	26.00	74.00	134.00	254.00	553.00	905.00	4175.00	8870.00
SURFACE AREA	0.	1.	2.	6.	7.	13.				
CAPACITY	0.	0.	16.	66.	102.	200.				
ELEVATION	769.	750.	760.	770.	780.	790.				

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
769.1	.0	.0	.0	.0	.0	.0	.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
773.2	.0	.0	0.

CREST LENGTH	0.	65.	100.	134.	150.
AT OR BELOW ELEVATION	773.1	773.4	773.7	774.3	775.0

DAM BREACH DATA

HBRID	Z	FLOW	TFAIL	WSEL	FAILEL
10.	.50	757.00	1.00	769.10	773.20

STATION USDAM, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	2.	2.
1.	1.	1.	1.	1.	2.	2.	3.	3.	3.
2.	2.	2.	2.	2.	2.	3.	4.	4.	4.
3.	3.	3.	3.	4.	4.	4.	5.	5.	5.
4.	4.	4.	4.	4.	4.	5.	5.	5.	5.
5.	5.	5.	5.	5.	5.	5.	5.	5.	

B L A C K   &   V E A T C H   PROJECT 9160.   DATE 27 AUG 80   PAGE 29

FLOOD HYDROGRAPH PACKAGE - HEC-1   PROGRAM H21702-00   TIME 1[illegible]   [illegible]

[illegible]

**********   **********   **********   **********   **********

SUB-AREA RUNOFF COMPUTATION

LOCAL RUNOFF INTO BECKMEYER LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
[illegible]	0	0	[illegible]	0	3	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.23	.00	.23	1.00	.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R96
.00	26.00	101.00	120.00	130.00	.00	.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	.00	.00	1.00	.00	.00	1.00	-1.00	-88.00	.00	.00

CURVE NO = -88.00   WETNESS = -1.00   EFFECT CN = 88.00

UNIT HYDROGRAPH DATA
TC= .00   LAG= .10

RECESSION DATA
STRTQ= .00   QRCSN= .00   RTIOR= 1.00

TIME INCREMENT TOO LARGE--(NHQ IS GT LAG/2)

UNIT HYDROGRAPH 8 END OF PERIOD ORDINATES, TC= .00 HOURS, LAG= .10 VOL= 1.00
[illegible]   [illegible]   [illegible]   [illegible]   [illegible]   19.   [illegible]   [illegible]

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	.00	.01	0.	1.01	12.05	145	.21	.20	.01	160.
1.01	.10	2	.01	.00	.01	0.	1.01	12.10	146	.21	.20	.01	262.
1.01	.15	3	.01	.00	.01	0.	1.01	12.15	147	.21	.20	.01	327.
1.01	.20	4	.01	.00	.01	0.	1.01	12.20	148	.21	.20	.01	345.
1.01	.25	5	.01	.00	.01	0.	1.01	12.25	149	.21	.20	.01	352.
[illegible]	[illegible]	[illegible]	.01	[illegible]	.01	0.	[illegible]	[illegible]	150	.21	[illegible]	.01	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.01	[illegible]	1.01	[illegible]	151	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.01	12.40	152	[illegible]	[illegible]	.01	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.01	0.	1.01	[illegible]	153	[illegible]	[illegible]	.01	[illegible]
1.01	.50	10	.01	.00	.01	0.	1.01	12.50	154	.21	[illegible]	.01	359.
1.01	.55	11	.01	.00	.01	0.	1.01	12.55	155	.21	[illegible]	.00	359.
1.01	1.00	12	.01	.00	.01	0.	1.01	13.00	156	.21	[illegible]	.00	360.
1.01	[illegible]	13	.01	.00	.01	0.	1.01	13.05	157	.25	[illegible]	.01	[illegible]
[illegible]	1.10	14	.01	[illegible]	.01	0.	1.01	13.10	158	.25	[illegible]	.01	411.
1.01	1.15	15	.01	.00	.01	0.	1.01	13.15	159	.25	.24	.00	425.

1.01	3.20	160	.01	.00	.01	0.	1.01	13.20	160	.25	.24	.00	411.
1.01	3.25	162	.01	.00	.01	0.	1.01	13.25	161	.25	.24	.00	411.
1.01	3.30	164	.01	.00	.01	0.	1.01	13.30	162	.25	.24	.00	414.
1.01	3.35	166	.01	.00	.01	0.	1.01	13.35	163	.25	.24	.00	415.
1.01	3.40	168	.01	.00	.01	0.	1.01	13.40	164	.25	.24	.00	415.
1.01	3.45	170	.01	.00	.01	0.	1.01	13.45	165	.25	.24	.00	416.
1.01	3.50	172	.01	.00	.01	0.	1.01	13.50	166	.25	.24	.00	416.
1.01	3.55	174	.01	.00	.01	1.	1.01	13.55	167	.25	.24	.00	416.
1.01	4.00	176	.01	.00	.01	1.	1.01	14.00	168	.25	.24	.00	416.
1.01	4.05	178	.01	.00	.01	2.	1.01	14.05	169	.31	.31	.00	418.
1.01	4.10	180	.01	.00	.01	2.	1.01	14.10	170	.31	.31	.00	416.
1.01	4.15	182	.01	.00	.01	2.	1.01	14.15	171	.31	.31	.00	416.
1.01	4.20	184	.01	.00	.01	3.	1.01	14.20	172	.31	.31	.00	544.
1.01	4.25	186	.01	.00	.01	3.	1.01	14.25	173	.31	.31	.00	545.
1.01	4.30	188	.01	.00	.01	4.	1.01	14.30	174	.31	.31	.00	547.
1.01	4.35	190	.01	.00	.01	4.	1.01	14.35	175	.31	.31	.00	547.
1.01	4.40	192	.01	.00	.01	4.	1.01	14.40	176	.31	.31	.00	548.
1.01	4.45	194	.01	.00	.01	5.	1.01	14.45	177	.31	.31	.00	548.
1.01	4.50	196	.01	.00	.01	5.	1.01	14.50	178	.31	.31	.00	548.
1.01	4.55	198	.01	.00	.01	5.	1.01	14.55	179	.31	.31	.00	548.
1.01	5.00	200	.01	.00	.01	6.	1.01	15.00	180	.31	.31	.00	549.
1.01	5.05	202	.01	.00	.01	6.	1.01	15.05	181	.19	.19	.00	488.
1.01	5.10	204	.01	.00	.01	6.	1.01	15.10	182	.38	.38	.00	492.
1.01	5.15	206	.01	.00	.01	7.	1.01	15.15	183	.38	.38	.00	545.
1.01	5.20	208	.01	.00	.01	7.	1.01	15.20	184	.57	.56	.00	733.
1.01	5.25	210	.01	.00	.01	7.	1.01	15.25	185	.66	.66	.00	910.
1.01	5.30	212	.01	.00	.01	8.	1.01	15.30	186	1.61	1.60	.01	3550.
1.01	5.35	214	.01	.00	.01	8.	1.01	15.35	187	2.66	2.63	.01	6289.
1.01	5.40	216	.01	.00	.01	8.	1.01	15.40	188	3.04	3.03	.00	8166.
1.01	5.45	218	.01	.00	.01	9.	1.01	15.45	189	.66	.66	.00	8274.
1.01	5.50	220	.01	.01	.01	9.	1.01	15.50	190	.57	.56	.00	8546.
1.01	5.55	222	.01	.01	.01	9.	1.01	15.55	191	.38	.38	.00	8122.
1.01	6.00	224	.01	.01	.01	9.	1.01	16.00	192	.38	.38	.00	852.
1.01	6.05	226	.01	.01	.01	9.	1.01	16.05	193	.29	.29	.00	696.
1.01	6.10	228	.01	.01	.01	10.	1.01	16.10	194	.29	.29	.00	566.
1.01	6.15	230	.01	.01	.01	10.	1.01	16.15	195	.29	.29	.00	540.
1.01	6.20	232	.01	.01	.01	10.	1.01	16.20	196	.29	.29	.00	543.
1.01	6.25	234	.01	.01	.01	10.	1.01	16.25	197	.29	.29	.00	518.
1.01	6.30	236	.01	.01	.01	11.	1.01	16.30	198	.29	.29	.00	516.
1.01	6.35	238	.01	.01	.01	11.	1.01	16.35	199	.29	.29	.00	515.
1.01	6.40	240	.01	.01	.01	11.	1.01	16.40	200	.29	.29	.00	515.
1.01	6.45	242	.01	.01	.01	11.	1.01	16.45	201	.29	.29	.00	515.
1.01	6.50	244	.01	.01	.01	11.	1.01	16.50	202	.29	.29	.00	515.
1.01	6.55	246	.01	.01	.01	11.	1.01	16.55	203	.29	.29	.00	515.
1.01	7.00	248	.01	.01	.01	12.	1.01	17.00	204	.29	.29	.00	515.
1.01	7.05	250	.01	.01	.01	12.	1.01	17.05	205	.23	.23	.00	484.
1.01	7.10	252	.01	.01	.01	12.	1.01	17.10	206	.23	.23	.00	417.
1.01	7.15	254	.01	.01	.01	12.	1.01	17.15	207	.23	.23	.00	417.
1.01	7.20	256	.01	.01	.01	12.	1.01	17.20	208	.23	.23	.00	406.
1.01	7.25	258	.01	.01	.01	13.	1.01	17.25	209	.23	.23	.00	406.
1.01	7.30	260	.01	.01	.01	13.	1.01	17.30	210	.23	.23	.00	405.
1.01	7.35	262	.01	.01	.01	13.	1.01	17.35	211	.23	.23	.00	405.
1.01	7.40	264	.01	.01	.01	13.	1.01	17.40	212	.23	.23	.00	405.
1.01	7.45	266	.01	.01	.01	13.	1.01	17.45	213	.23	.23	.00	405.
1.01	7.50	268	.01	.01	.01	13.	1.01	17.50	214	.23	.23	.00	405.
1.01	7.55	270	.01	.01	.01	13.	1.01	17.55	215	.23	.23	.00	405.

1.01	5.00	72	.01	.01	.01	14.	1.01	17.55	211	.23	.23	.00	405.
1.01	5.05	69	.01	.01	.01	13.	1.01	17.60	212	.23	.23	.00	405.
1.01	5.05	69	.01	.01	.01	13.	1.01	17.65	213	.23	.23	.00	405.
1.01	5.10	70	.01	.01	.01	13.	1.01	17.70	214	.23	.23	.00	405.
1.01	5.15	71	.01	.01	.01	13.	1.01	17.75	215	.23	.23	.00	405.

1.01	6.00	72	.01	.01	.01	14.	1.01	18.00	216	.23	.23	.00	405.
1.01	6.05	74	.04	.04	.03	29.	1.01	18.05	217	.02	.02	.00	301.
1.01	6.10	76	.06	.04	.03	52.	1.01	18.10	218	.02	.02	.00	146.
1.01	6.15	77	.06	.06	.04	64.	1.01	18.15	219	.02	.02	.00	79.
1.01	6.20	76	.06	.04	.02	70.	1.01	18.20	220	.02	.02	.00	52.
1.01	6.25	77	.06	.04	.04	74.	1.01	18.25	221	.02	.02	.00	42.
1.01	6.30	77	.06	.06	.04	75.	1.01	18.30	222	.02	.02	.00	38.
1.01	6.35	79	.06	.05	.02	79.	1.01	18.35	223	.02	.02	.00	37.
1.01	6.40	80	.06	.05	.02	81.	1.01	18.40	224	.02	.02	.00	36.
1.01	6.45	81	.06	.05	.02	82.	1.01	18.45	225	.02	.02	.00	36.
1.01	6.50	84	.06	.05	.02	84.	1.01	18.50	226	.02	.02	.00	36.
1.01	6.55	87	.06	.05	.02	87.	1.01	18.55	227	.02	.02	.00	36.
1.01	7.00	86	.06	.05	.02	87.	1.01	19.00	228	.02	.02	.00	36.
1.01	7.05	88	.06	.05	.01	89.	1.01	19.05	229	.02	.02	.00	36.
1.01	7.10	88	.06	.05	.01	89.	1.01	19.10	230	.02	.02	.00	36.
1.01	7.15	89	.06	.05	.01	91.	1.01	19.15	231	.02	.02	.00	36.
1.01	7.20	90	.06	.05	.01	92.	1.01	19.20	232	.02	.02	.00	36.
1.01	7.25	89	.06	.05	.01	91.	1.01	19.25	233	.02	.02	.00	36.
1.01	7.30	91	.06	.05	.01	93.	1.01	19.30	234	.02	.02	.00	36.
1.01	7.35	91	.06	.05	.01	93.	1.01	19.35	235	.02	.02	.00	36.
1.01	7.40	92	.06	.05	.01	93.	1.01	19.40	236	.02	.02	.00	36.
1.01	7.45	93	.06	.05	.01	95.	1.01	19.45	237	.02	.02	.00	36.
1.01	7.50	94	.06	.05	.01	97.	1.01	19.50	238	.02	.02	.00	36.
1.01	7.55	97	.06	.06	.01	99.	1.01	19.55	239	.02	.02	.00	36.
1.01	8.00	99	.06	.06	.01	99.	1.01	20.00	240	.02	.02	.00	36.
1.01	8.05	99	.06	.06	.01	99.	1.01	20.05	241	.02	.02	.00	36.
1.01	8.10	99	.06	.06	.01	99.	1.01	20.10	242	.02	.02	.00	36.
1.01	8.15	99	.06	.06	.01	100.	1.01	20.15	243	.02	.02	.00	36.
1.01	8.20	100	.06	.06	.01	101.	1.01	20.20	244	.02	.02	.00	36.
1.01	8.25	101	.06	.06	.01	101.	1.01	20.25	245	.02	.02	.00	36.
1.01	8.30	102	.06	.06	.01	102.	1.01	20.30	246	.02	.02	.00	36.
1.01	8.35	103	.06	.06	.01	102.	1.01	20.35	247	.02	.02	.00	36.
1.01	8.40	104	.06	.06	.01	102.	1.01	20.40	248	.02	.02	.00	36.
1.01	8.45	105	.06	.06	.01	103.	1.01	20.45	249	.02	.02	.00	36.
1.01	8.50	105	.06	.06	.01	103.	1.01	20.50	250	.02	.02	.00	36.
1.01	8.55	106	.06	.06	.01	104.	1.01	20.55	251	.02	.02	.00	36.
1.01	9.00	107	.06	.06	.01	104.	1.01	21.00	252	.02	.02	.00	36.
1.01	9.05	109	.06	.06	.01	104.	1.01	21.05	253	.02	.02	.00	36.
1.01	9.10	110	.06	.06	.01	105.	1.01	21.10	254	.02	.02	.00	36.
1.01	9.15	111	.06	.06	.01	105.	1.01	21.15	255	.02	.02	.00	36.
1.01	9.20	112	.06	.06	.01	105.	1.01	21.20	256	.02	.02	.00	36.
1.01	9.25	113	.06	.06	.01	106.	1.01	21.25	257	.02	.02	.00	36.
1.01	9.30	114	.06	.06	.01	106.	1.01	21.30	258	.02	.02	.00	36.
1.01	9.35	115	.06	.06	.01	106.	1.01	21.35	259	.02	.02	.00	36.
1.01	9.40	116	.06	.06	.01	106.	1.01	21.40	260	.02	.02	.00	36.
1.01	9.45	117	.06	.06	.01	107.	1.01	21.45	261	.02	.02	.00	36.
1.01	9.50	118	.06	.06	.01	107.	1.01	21.50	262	.02	.02	.00	36.
1.01	9.55	119	.06	.06	.01	107.	1.01	21.55	263	.02	.02	.00	36.
1.01	10.00	120	.06	.06	.01	107.	1.01	22.00	264	.02	.02	.00	36.
1.01	10.05	121	.06	.06	.00	107.	1.01	22.05	265	.02	.02	.00	36.
1.01	10.10	122	.06	.06	.00	108.	1.01	22.10	266	.02	.02	.00	36.
1.01	10.15	123	.06	.06	.00	108.	1.01	22.15	267	.02	.02	.00	36.
1.01	10.20	124	.06	.06	.00	108.	1.01	22.20	268	.02	.02	.00	36.
1.01	10.25	125	.06	.06	.00	108.	1.01	22.25	269	.02	.02	.00	36.
1.01	10.30	126	.06	.06	.00	109.	1.01	22.30	270	.02	.02	.00	36.
1.01	10.35	127	.06	.06	.00	109.	1.01	22.35	271	.02	.02	.00	36.

1.01	10.20	126	.06	.06	.00	109.	1.01	22.40	272	.02	.02	.00	36.
1.01	10.25	127	.06	.06	.00	109.	1.01	22.45	273	.02	.02	.00	36.
1.01	10.30	128	.06	.06	.00	109.	1.01	22.50	274	.02	.02	.00	36.
1.01	10.35	129	.06	.06	.00	109.	1.01	22.55	275	.02	.02	.00	36.
1.01	10.40	130	.06	.06	.00	109.	1.01	23.00	276	.02	.02	.00	36.
1.01	10.45	131	.06	.06	.00	109.	1.01	23.05	277	.02	.02	.00	36.
1.01	10.50	132	.06	.06	.00	109.	1.01	23.10	278	.02	.02	.00	36.
1.01	10.55	133	.06	.06	.00	109.	1.01	23.15	279	.02	.02	.00	36.
1.01	11.00	134	.06	.06	.00	110.	1.01	23.20	280	.02	.02	.00	36.
1.01	11.05	135	.06	.06	.00	110.	1.01	23.25	281	.02	.02	.00	36.
1.01	11.10	136	.06	.06	.00	110.	1.01	23.30	282	.02	.02	.00	36.
1.01	11.15	137	.06	.06	.00	110.	1.01	23.35	283	.02	.02	.00	36.
1.01	11.20	138	.06	.06	.00	110.	1.01	23.40	284	.02	.02	.00	36.
1.01	11.25	139	.06	.06	.00	110.	1.01	23.45	285	.02	.02	.00	36.
1.01	11.30	140	.06	.06	.00	110.	1.01	23.50	286	.02	.02	.00	36.
1.01	11.35	141	.06	.06	.00	111.	1.01	23.55	287	.02	.02	.00	36.
1.01	11.40	142	.06	.06	.00	111.	1.02	.00	288	.02	.02	.00	36.
1.01	11.45	143	.06	.06	.00	111.							
1.01	11.50	144	.06	.06	.00	111.							

SUM 31.98 30.40 1.56 54055.
(812.)(772.)(40.)(1530.67)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3126.	605.	188.	188.	54056.
CMS	89.	17.	5.	5.	1531.
INCHES		24.47	30.37	30.37	30.37
MM		621.65	771.27	771.27	771.27
AC-FT		300.	372.	372.	372.
THOUS CU M		370.	459.	459.	459.

HYDROGRAPH AT STABENHEAD FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	313.	60.	19.	19.	5406.
CMS	9.	2.	1.	1.	153.
INCHES		2.45	3.04	3.04	3.04
MM		62.14	77.13	77.13	77.13
AC-FT		30.	37.	37.	37.
THOUS CU M		37.	46.	46.	46.

HYDROGRAPH AT STABENHEAD FOR PLAN 1, RTIO 2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	469.	91.	28.	28.	8106.
CMS	13.	3.	1.	1.	230.
INCHES		3.67	4.55	4.55	4.55
MM		93.21	115.69	115.69	115.69
AC-FT		45.	56.	56.	56.
THOUS CU M		55.	69.	69.	69.

HYDROGRAPH AT STABENHEAD FOR PLAN 1, RTIO 3

HYDROGRAPH ROUTING

ROUTE THROUGH RECHEMEYER DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
UHDAM	1	0	0	0	3	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
.0	.000	.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	.000	.000	.000	-750.	-1

STAGE	750.00	754.00	753.00	754.00	755.00	756.00	757.00	760.00	762.00
FLOW	.00	7.00	30.00	166.00	484.00	976.00	1620.00	4150.00	6520.00

SURFACE AREA=	0.	4.	4.	8.	15.	25.
CAPACITY=	0.	4.	29.	46.	201.	401.
ELEVATION=	725.	730.	740.	750.	760.	770.

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
750.0	.0	.0	.0	.0	.0	.0	.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
755.9	.0	.0	0.

CREST LENGTH AT OR BELOW ELEVATION	0.	5.	71.	140.	300.	309.	321.	321.
	753.9	754.0	755.0	755.3	755.8	757.0	759.0	765.0

STATION [illegible], PLAN [illegible], RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	3.	3.	3.	3.	3.

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 .10	RATIO 2 .15	RATIO 3 .20	RATIO 4 .50	RATIO 5 1.00
HYDROGRAPH AT	US ROAD	.13	1	240.	340.	440.	1200.	2401.
		(.34)	(	6.80)(	10.20)(	13.60)(	33.99)(	67.99)(
POOLED FR	US ROAD	.34	1	61.	90.	137.	585.	1670.
		(.88)	(	1.72)(	2.59)(	3.87)(	27.00)(	47.29)(
HYDROGRAPH AT	DOWNSTR	.23	1	115.	464.	825.	1563.	3126.
		(.61)	(	8.85)(	13.26)(	17.71)(	44.26)(	88.53)(
2 COMBINED		.57	1	362.	550.	747.	2327.	4796.
		(1.50)	(	10.38)(	15.76)(	21.16)(	65.90)(	135.82)(
ROUTED TO	DOWNST	.57	1	99.	267.	435.	1901.	4503.
		(1.50)	(	2.79)(	7.53)(	11.75)(	53.84)(	127.54)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	769.10	769.10	774.20
STORAGE	60.	60.	60.
OUTFLOW	3.	3.	916.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	770.76	.00	67.	61.	.00	15.83	.00
.15	771.41	.00	51.	98.	.00	15.83	.00
.20	772.04	.00	54.	137.	.00	15.83	.00
.50	774.04	.44	64.	987.	.42	16.52	15.58
1.00	773.22	.02	60.	1070.	.27	15.67	14.42

FLOOD HYDROGRAPH PACKAGE (HEC-1)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	750.00	750.00	757.90
STORAGE	86.	86.	1420.
OUTFLOW	0.	0.	1564.

RATIO OF PMF	MAXIMUM RESERVOIR	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	755.50	.00	118.	99.	.00	16.75	.00
.15	756.24	.34	125.	247.	1.58	15.92	.00
.20	756.67	.77	131.	415.	2.75	15.83	.00
.50	757.33	2.26	147.	1403.	5.63	15.75	.00
1.00	757.74	2.74	151.	4303.	8.17	15.67	.00

END

DATE
FILMED

11-81

DTIC